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ORIGINAL ARTICLES

A CRITICAL ANALYSIS OF INVESTIGATIONS INTO FACIAL GROWTH CHANGES*

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INTRODUCTION

SINCE Simon in 1922 suggested that the relative positions, anteroposteriorly, of orbital plane and dental arch were established by the age of five years and tended to remain unaffected by subsequent growth changes in the face, certain attempts have been made to submit this supposition to the test of measurement on series of living heads and crania. In addition to direct measurement of orbitodental relationships in the growing face, other relationships likely to be associated more or less closely with these have also been subjected to measurement. Now exact observation on an adequate number of individuals is the only sound way in which to establish or disprove a theory of this kind, and I wish to preface this critical analysis of the results obtained thus far by paying a tribute to those who have carried out the investigations. Such investigations entail much labor, patience, and scientific enterprise. They present many difficulties, often unrealized, for which a dental training provides no preparation. And whether they attain, fall short of, or miss the goal of their first quests, the thing is that they set out, and that that same scientific enterprise will succeed next time. A critical analysis of these first results is not prompted by the desire to be carping and unhelpful: its aims are two and both constructive. The first is to consider as carefully as possible what the various data represent and to assess the knowledge gained as a result of these enquiries. The second, and far more important aim, is to call attention to any errors of technic or interpretation that have falsified the conclusions drawn, and by thus putting up large notice boards

*Paper presented before the Second International Orthodontic Congress, London, July, 1931.

over stumbling blocks and pitfalls, to make it easier for future orthodontic enquiries to avoid them. The first constructive step in this direction is to make the fact of their existence abundantly clear. As to avoiding them, the best way in most cases would be to engage the assistance of a pilot! When the trained observer seeks the cooperation of the trained statistician in dealing with his data, the results are more likely to be valid and pregnant than if either works alone.

ORBITODENTAL GROWTH CHANGES

1. *Investigations on Children in Bonn*

Let us first examine the data obtained concerning the population of Bonn, or rather that section of it which possesses anatomically correct occlusion. Two samples of this population, consisting in each case of 137 individuals, have been examined by workers in the University Clinic there. The first sample was measured in 1923 by Dr. Karl Herzog, the second in 1929 by Drs. Linder and Harth. The second investigation was undertaken because the apparatus used by Herzog was not the same as that used by Simon, and it was judged that the substitution of the orbital spectacles for the gnathostat might perhaps have affected the results.

Herzog's findings have been frequently quoted by English-speaking orthodontists who, however, have been under the disadvantage of quoting at second hand, the journal in which the German version appeared having only a small circulation in England and America. I have therefore translated this paper by kind permission of author and editor and analyzed its results. As it seems more suitable to publish the discussion of Herzog's findings with the English translation of his paper, we shall consider here only the results of the more recent investigation, that by Linder and Harth.

Simon's orbitale lies not on, but somewhat in front of, the orbital rim.* Its lateral position is determined by the pupil of the forward-looking eye; its anteroposterior position by a vertical bar pressed up against the bony ridge which juts out below the rim and overhangs the canine fossa, a thin covering of skin and muscle separating bar from bone. The following diagram, from a paper by Linder,† shows the distribution of his orbital plane for boys and girls combined, at three different stages of development. The diagram (Fig. 1) gives us the percentage distribution for three dentition groups: Group I, first permanent molar erupted, deciduous dentition still in place; Group II, all permanent dentition in place except third molar, second molar having only recently erupted; Group III, a space several millimeters long between maxillary tuberosity and second molar, to make room for third molar. Linder infers from these data that the position of the orbital plane as defined by Simon is different at these three different age periods in the population represented by the samples. Now I want to point out that this conclusion is by no means obvious from a mere inspection of the distributions as shown in his figure. To begin with, the scale used to register the anteroposterior position of Simon's orbital point relative to the dental arch is not the same in Group I as in the two older groups. The deciduous

*Exact position discussed and figured in Orthodontic Standards, Dental Record, 1931.
†Fortschritte der Orthodontik, Fig. 14, **1**: 221, 1931.

canine and molars, viewed in *norma lateralis,* may together occupy about as much space as the permanent canine and premolars, but they obviously do not share it in the same proportions. The deciduous canine has a smaller average width than the first deciduous molar, and the first molar than the second; whereas in the permanent dentition their projected widths are more nearly equal. Obviously, therefore, if in a group of children the distances between the orbital plane and the posterior border of the permanent lateral incisor remained absolutely unchanged after the eruption of this tooth, its position as recorded on the deciduous dentition would give fewer cases to the canine than when, later on, it was recorded on the permanent dentition, simply because the permanent canine occupies more room; and there would be corresponding changes in regard to the other teeth. To compare the distribution of Simon's orbital plane on the teeth of Group I with that for Groups II and III without making allow-

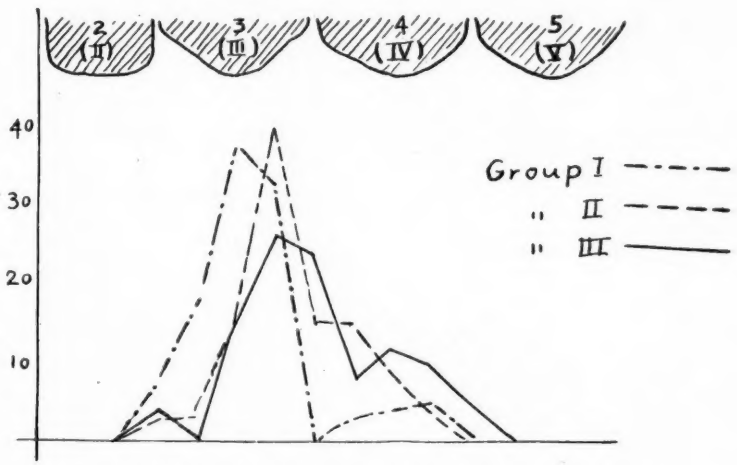

Fig. 1.—Orbitocanine relation (after Linder and Harth).

ances for this change of scale, is like comparing the number of yards and inches in one piece of cloth with the number of meters and centimeters in another.

But abandoning direct comparison of Group I with the two groups in Fig. 1 which relate to the permanent dentition, what about the comparison of these with each other (assuming, of course, that there is no tendency for the relative positions of permanent teeth to change once they are fully erupted and none lost)? Can we not immediately conclude from the observed differences between these two groups that age changes of the kind we are considering do take place during the teens? We can not; for the two sample series measured cannot be relied upon to give us distributions exactly like those that would be obtained from the whole of the two classes (in statistical language, the two populations) from which they were drawn, namely from all the correctly occluded children of Bonn and neighborhood of the appropriate age ranges. No two samples drawn from the same population are likely to be exactly the same as one another, nor exactly representative of the population from which they are drawn. We want therefore to know how much of the difference between the distributions of these two samples of children is likely to be due merely to chance in sampling. We

can then make allowance for that difference, and consider only that which is likely to be due to actual differences between the two dentition stages they represent. Let us see then what further data are required in order to make the necessary calculations. First we need to know the number in each series measured, since the larger the sample the more likely it is to be representative of the population to which it belongs. Though the numbers are not given by Linder in the paper we are considering, they are given in an earlier paper by him, and also in one by Harth: forty boys and girls in Group II and fifty-three in Group III. (Group I numbered 44.)

At this point another question arises which must be satisfactorily answered before we can proceed further with data on mixed sexes: do the sexes tend to differ in regard to the relative anteroposterior positions of Simon's *orbitale* and the dental arch? If so, differences between the graphs might be due to their representing boys and girls mixed in difference proportions. Dr. Linder gives us some material on which to base an answer to the question thus raised, showing together in his Figs. 11, 12, and 13 (loc. cit. pp. 212-214) the separate graphs for

TABLE I
DISTRIBUTION OF ORBITAL PLANE IN 137 CORRECTLY OCCLUDED CHILDREN
(AFTER LINDER AND HARTH)

CATEGORIES	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTALS
Group I ♂	1	5	9	10	–	1	–	2	–	–	–	–	–	28
♀	2	3	7	4	–	–	–	–	–	–	–	–	–	16
Group II ♂	–	–	1	10	4	2	2	–	–	–	–	–	–	19
♀	1	1	5	6	2	4	1	1	–	–	–	–	–	21
Group III ♂	1	–	3	6	4	–	1	1	–	–	–	–	–	16
♀	1	–	5	8	8	4	5	4	2	–	–	–	–	37

boys and girls in each dentition group; but here again, in order to test whether boys and girls differ in regard to the position of the orbital plane, or whether the differences between the corresponding graphs are probably due only to chance in sampling, we need to know how many children each graph represents. Dr. Harth has very kindly sent me all the data available that can be used to answer these various questions, including the absolute numbers of the distributions for the two sexes in all the three dentition groups represented in Fig. 1.

The age distributions of the above 137 children are shown in Table II.

The categories into which the data of Table I are grouped, are determined by certain points, as follows: three of the points are situated at the tip of the cusps of canine and premolars respectively*; the points of contact of all adjacent teeth from lateral incisor to first permanent molar (or, if they do not touch, the midpoints of the spaces between them) provide four which alternate with the first three; points bisecting each successive interval between the above seven points make six more—thirteen in all numbered 1-13, beginning at the point of contact between lateral incisor and canine and ending with the point of contact between second premolar and first molar. These numbers are used in Table I, but in Linder's diagram (Fig. 1) are replaced by drawings of the teeth them-

*In the case of the milk teeth, the groove between the pair of milk-molar buccal cusps is used in place of the premolar cusp.

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selves. The positions of Simon's orbital plane were found not to range over the whole of the teeth thus divided, but only from category 1 to category 9.

It will be realized from the above description that the points used in Linder's classification do not all follow at equal intervals,* since the three cusps used do not lie exactly in the middle of their respective teeth as viewed in *norma lateralis.* That means that the categories into which the positions of the orbital plane are classified are not all equal; and we have already realized that the relative sizes of the categories will of themselves affect the distribution of the cases. Unless, therefore, we have exact data as to the mean size of each category, we cannot plot out correctly the distribution of Simon's orbital plane, and we cannot use exact methods in working out the probability that the two populations represented by

TABLE II
AGE DISTRIBUTIONS (LINDER AND HARTH)

	5-6 YR.	6-7 YR.	7-8 YR.				TOTAL NO.	AVERAGE AGE
Group I ♂	2	21	5				28	6 years 8 months
♀	1	12	3				16	6 years 7 months
	11-12 YR.	12-13 YR.	13-14 YR.	14-15 YR.				
Group II ♂	2	5	5	7			19	13 years 3 months
♀	1	2	10	8			21	13 years 7 months
	14-15 YR.	15-16 YR.	16-17 YR.	17-18 YR.	18-19 YR.	19-20 YR.		
Group III ♂	4	2	4	2	1	3	16	16 years 9 months
♀	4*	5	15	6	5	2	37	17 years 1 month

*Including one girl aged thirteen years, eleven months.

the two older series measured were alike, or differed from one another in this respect.

What we could do with the data as they stand—on the assumption that the relative sizes of the categories are at any rate the same for both series—would be to treat the categories as merely qualitative, with no significance as to their order, just as we should if they represented colors, for example, and we had to decide by calculation whether two different assortments of colored marbles in two different handfuls were likely to have been obtained by dipping the hand into the same bag of assorted marbles, or into two bags containing different assortments. Fortunately we are not obliged to content ourselves with the much rougher estimates that these calculations would have yielded. So thorough were the investigations of Linder and Harth that they measured the intervals between all of their 13 points and also two additional ones,† on each of the 137

*Linder made a slip in stating (Fortschr. d. Orth. **1**: p. 218) that the range was divided "in zehn voneinander gleich weit entfernte Punkte."

†These were the lowest point (00) of the lateral incisor as projected, and the point (0) midway between 00 and 1.

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children, both left and right side. I have to express my warmest thanks to Dr. Harth for undertaking the considerable labor of copying out for me all these individual measurements and permitting me to use them. They have now been reduced to their mean values, which are given, and discussed, later on in this paper. With these data at our service we can use more exact methods in interpreting the graphs; and, since the measurements relate to both deciduous teeth and permanent, they will enable us to reduce the frequencies of all three graphs in Fig. 1 to a common basis, and thus to compare all three.

The mean position of Simon's orbital plane in our various groups is given in Table III. As it was found that the space occupied by the deciduous canine and

TABLE III

POSITION OF SIMON'S ORBITAL PLANE ON 137 CORRECTLY OCCLUDED CHILDREN (AFTER LINDER AND HARTH)

	NO.	MEAN DISTANCE BEHIND |II/III OR |2/3	MEAN DISTANCE IN FRONT OF |V/6 OR |5/6	STANDARD ERROR OF MEAN	STANDARD DEVIATION	STANDARD ERROR OF S. D.	MEAN DISTANCE BEHIND CANINE TIP
Group I, ♂	28	3.52 mm.	17.45 mm.	0.45 mm.	2.39 mm.	0.32 mm.	1.02 mm.
Group II, ♂	19	5.90 mm.	14.13 mm.	0.44 mm.?	1.90 mm.	0.31 mm.?	3.21 mm.
Group III, ♂	16	5.27 mm.	14.76 mm.	0.67 mm.?	2.67 mm.	0.47 mm.?	2.58 mm.
Group I, ♀	16	2.28 mm.	17.69 mm.	0.32 mm.?	1.26 mm.	0.22 mm.?	0.05 mm.
Group II, ♀	21	5.14 mm.	14.21 mm.	0.61 mm.?	2.78 mm.	0.43 mm.?	2.71 mm.
Group III, ♀	37	6.77 mm.	12.58 mm.	0.51 mm.	3.12 mm.	0.36 mm.	4.34 mm.
Group I, ♂+$\overline{♀ \times 1.05}$	44	3.11 mm.	17.86 mm.	0.32 mm.	2.14 mm.	0.23 mm.	0.66 mm.
Group II, ♂+$\overline{♀ \times 1.035}$	40	5.60 mm.	14.43 mm.	0.39 mm.	2.48 mm.	0.28 mm.	3.03 mm.
Group III, ♂+$\overline{♀ \times 1.035}$	53	6.49 mm.	13.54 mm.	0.44 mm.	3.18 mm.	0.31 mm.	3.92 mm.
Groups II + III, ♂	35	5.61 mm.	14.42 mm.	0.39 mm.	2.31 mm.	0.28 mm.	2.92 mm.
Groups II + III, ♀	58	6.18 mm.	13.17 mm.	0.40 mm.	3.08 mm.	0.29 mm.	3.75 mm.
Groups II + III, ♂ + $\overline{♀ \times 1.035}$	93	6.10 mm.	13.93 mm.	0.30 mm.	2.93 mm.	0.21 mm.	3.53 mm.

deciduous molars was the same as that occupied by the permanent canine and premolars, Linder and Harth's point 1 (point of contact between canine and lateral incisor, or, if a gap be seen between them when viewed in *norma lateralis*, the midpoint of that gap) and point 13 (the corresponding point between second deciduous molar, or second premolar, and first permanent molar) were chosen as the points from which to measure the distance of Simon's orbital plane, though the distance from canine tip is also given in the table. The columns giving the mean distances from the selected points in the actual samples measured, are followed by a column which forecasts the corresponding means in the "populations" represented by these small samples. For the smallest samples the forecasts are queried because there are not enough data to make a really reliable forecast. With a sample of about 30 to 40 rather more confidence is felt, but 50 to 100 are needed to make these forecasts really reliable. The interpretation of the figures given in Table III may be illustrated by its application to the first line of the table. The mean position of the plane in 28 correctly occluded boys be-

tween the ages of five and eight years was found to be 3.52 mm. behind the point of contact of lateral incisor and canine; *the odds would be about 2 to 1* that its mean position in the "population" from which they are drawn is somewhere between $\overbrace{3.52+0.45}$ and $\overbrace{3.52-0.45}$ mm.—in round numbers 3 to 4 mm.—behind this point. The next column gives the standard deviation of the sample, and this is followed by the standard error of the standard deviation. If the mean and standard deviation of the observed distance in these 28 boys were to give correctly the corresponding values in the whole "population" of correctly occluded five- to eight-year-old boys, then in about two-thirds of that "population" the orbital plane (if following a Normal distribution) would lie within the limits of $\overbrace{3.52-2.39}$ mm. and $\overbrace{3.52+2.39}$ mm.—that is, omitting fractions, 1 to 6 mm.—behind the point chosen.

Such is the meaning of the actual figures; but what answer do they give us to our problem? It is quite easy to see from the table that in the actual samples measured, the mean position of the orbital plane is farther forward in the children with deciduous dentition than in those with 28 permanent teeth, whether we take boys and girls singly or together; also that whereas its mean position in the oldest group of girls is still farther back than in the middle group, the corresponding figure for the boys shows it to be farther forward. But these particular children do not interest us; and how can we read off from this table the growth changes that take place between the ages of five and twenty years? They cannot be read off direct. In order to disentangle the effect of growth from the results of chance in sampling, a statistical estimate must be made of the chances of getting the observed differences in samples from the *same* "population." The test applied is the λ_H test given and tabled by E. S. Pearson and J. Neyman,* which gives the following results. Taking our groups in pairs, the estimated chances of getting by random sampling from the same population a difference as big as or bigger than that between the respective groups are:

Group I ♂ and Group I ♀ $\times$ 1.05†: 10 chances in 100.

Group II ♂ and Group II ♀ $\times$ 1.035†: 25 chances in 100.

Group III ♂ and Group III ♀ $\times$ 1.035†: 21 chances in 100.

We see that such difference as is found between the sexes in our samples may be accounted for by random sampling. If any real difference exists between these "populations" it will need larger samples to demonstrate it.

Group I ♂ and Group II ♂: 0 chances in 100.
Group I ♀ and Group II ♀: 0 chances in 100.

Since chance will not account for the difference between the youngest and the middle group, either boys or girls, we can safely conclude that a growth change is demonstrated whether measured from our "fixed points" on the dental

*"On the Problem of Two Samples," Bulletin de l'Acad. polonaise des Sciences et des Lettres, Série A, 1930, pp. 73-96. Table also published in Tables for Statisticians & Biometricians edited by Karl Pearson, F.R.S., ed. 2, 1931, Table XXXVII. Applicable only to Normal or nearly Normal distributions.

†The values for girls have been increased in the proportions given, to make them comparable with those for boys.

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arch, or from the tip of the canine—deciduous or permanent as the case may be. With this demonstration it is seen that Simon's theory of a constant average relation between orbital plane and canine tip (as measured by the technic he specifies) from the age of five years upward, is refuted by the observations of Linder and Harth.

Group II ♂ and Group III♂: 45 chances in 100.
Group II ♀ and Group III ♀: 22 chances in 100.

No change is demonstrated between the position of the plane in the earlier and the later teens, whether on boys or girls, for the differences shown can very easily be brought about by chance in sampling. But in order to reduce the effect of chance in sampling we shall increase our numbers for Groups II and III to 40 and 53 respectively by pooling the sexes, no sex difference having been proved. The result we then obtain is:

Group II and Group III, combined sexes: 16 chances in 100.

Chance would still account for the difference about one time in six, and therefore we cannot infer from these data that any change in the relative forward positions of dental arch and orbital plane takes place between the given ages. If any, it is likely to be slight, and considerably larger samples are needed before it can be demonstrated.

As a result of the researches of Linder and Harth the orthodontic world is now in a position to argue about the application, the merits, or the demerits of the technic in question from a basis of certain firm facts. Such contribution as the present writing may have to make to the discussion shall, however, be deferred until the results of an investigation on another population than that of Bonn have been examined and assessed.

2. *Investigations on American Indian Crania*

From the school at Bonn we pass to consider the observations of a distinguished American orthodontist, Dr. Milo Hellman. He has investigated the position of the craniometric orbital plane (situated farther back than Simon's cephalometric) on a series of 103 American Indian crania at all stages of growth from infancy to senility. His results are expressed as percentage distributions in Fig. 2.*

It will be seen that his material is divided into seven groups; of these, No. 1 to 4 are nonadult. Hellman, like Linder, concludes from his distributions that age changes certainly occur. Again we want to know much more before we can agree, the first question being: how many individuals are there in each group? The answer is that Groups I to VII contain 7, 9, 17, 10, 20, 22 and 18 skulls respectively. Now even with the largest of these groups chance in sampling plays a considerable part and has to be allowed for before one can draw conclusions; and in the smaller samples, it is so large that their percentage distributions may be very misleading. Though the distributions for Groups I and II, for example, are represented here as different from one another, and convey the impression of a growth change, the figures given do not in fact demonstrate any growth change whatever. If one were to pick out at random from exactly the same "popula-

*Internat. J. Orthod. Oral Surg. & Radiog. **16**: 157, 1930.

tion'' (representing Stages I to II combined), two samples containing 7 and 9 individuals respectively, the odds are 7 to 3 that the distributions of these two samples would differ from each other no more than do those of Hellman's 7 at Stage I, and 9 at Stage II. If, however, the percentages given in Fig. 2 had represented even 20 individuals at each of the two stages, the odds as calculated would have been less than 1 in 1,000 in favor of the percentage differences being accounted for by chance alone.*

The percentage distributions of Fig. 2 being useless for sound inference as they stand, there would have to be some pooling of groups to get numbers large enough to form a reliable basis on which to demonstrate age changes in the distribution of the orbital plane. I have, however, refrained from undertaking the calculations entailed by this procedure because a careful study of Hellman's technic as he describes it makes one doubtful of the reliability of his records. He

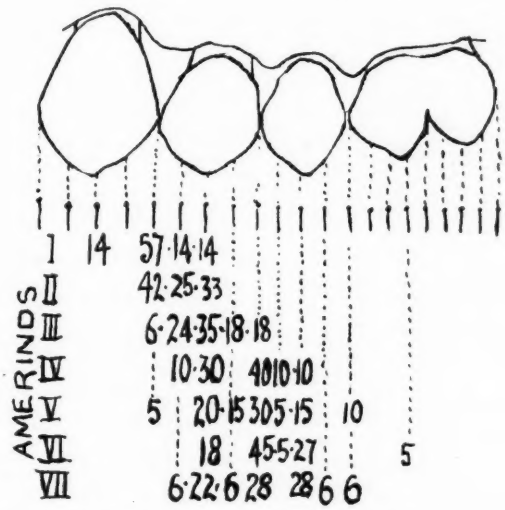

Fig. 2.—Percentage distribution of craniometric orbital plane at different dental stages (after Hellman).

determined the orbital plane by means of a pair of calipers, the skull being orientated to the Frankfort plane. He was able to keep the stem of the calipers upright by keeping it parallel to the vertical rod of the craniostat that held the skull; but did he always keep the plane of the calipers at right angles to the median plane? *Could* he, in fact, always do this? There are orbits so shaped that calipers could not remain at right angles and at the same time rest their upper arm on the orbital point. Yet if the calipers were not parallel to the transverse plane but slewed round somewhat so that the upper arm pointed into the orbit, the lower arm would touch the dental arch farther back than if the calipers were in the correct position. While reflecting on these possibilities, it occurred to me that Hellman having also measured 34 of the 75 adult white skulls which Broadbent had previously measured with the very accurate instrument used at Western Reserve University, a comparison of their respective distributions might show how far Hellman's technic can be relied upon. These

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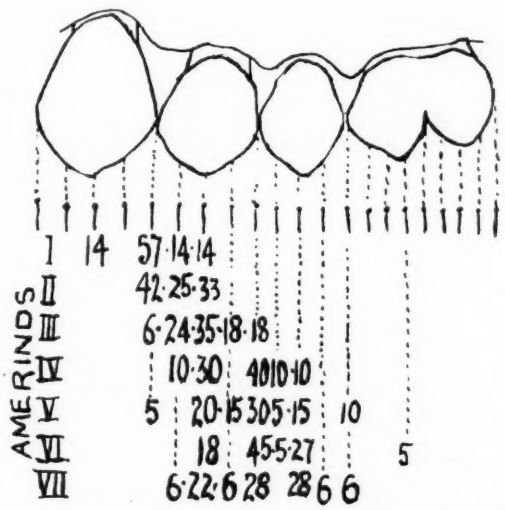

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two observers divided up the tooth in different ways, but even so, a diagram (Fig. 3) will show clearly the difference between them.

We must consider Hellman's distribution in the amended form in which it is shown in the top line of figures on the diagram, for he has yielded unconsciously to a temptation common to almost all recorders. He has tended to favor certain categories.*. Having divided up each tooth into four equal quarters, he has put as many cases as possible into the categories centering between two teeth or in the middle of a tooth, to the depletion of the "quarter" categories. Hence a very uneven distribution, which cannot be used as it stands, but has to be corrected by combining favored and neglected categories together in pairs. The same tendency can be observed in many other records: the worker will take most of his measure-

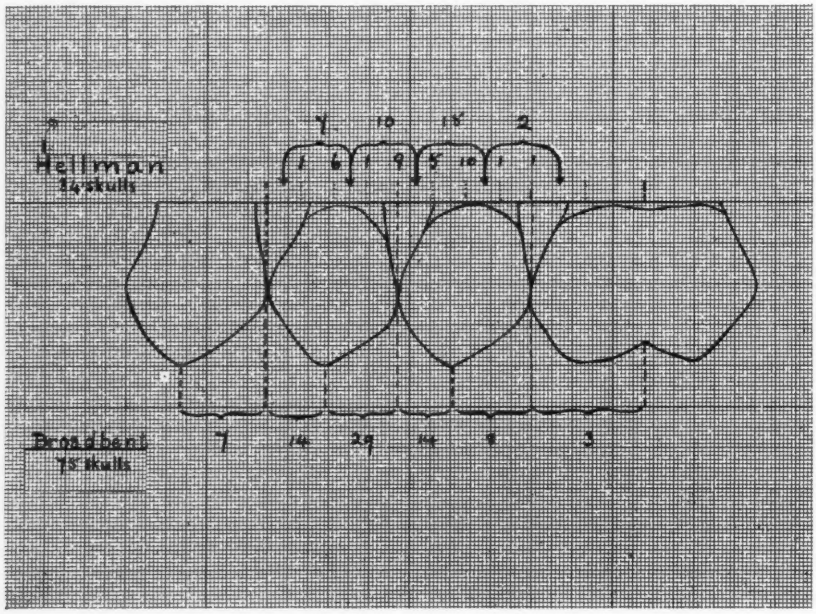

Fig. 3.—Distribution of craniometric orbital plane on seventy-five male white skulls (after Broadbent), and on thirty-four of the same skulls (after Hellman).

ments to the nearest millimeter, say, with a few cases only to .5 mm. But whatever the unit chosen—whether half or a tenth of a millimeter, a quarter of a tooth, half a decade, or what not—the estimate must be made as exact as possible within the selected limits of accuracy. It needs to be realized that failure to do this always constitutes a source of error, not perhaps in the mean values obtained, but invariably—unless provided against—in the calculations of variability.

But now to compare the two distributions shown in Fig. 3. Broadbent's begins upon the distal edge of the canine; Hellman's farther back in the middle of the mesial edge of the first premolar. Broadbent's maximum incidence is on the distal edge of the first premolar; Hellman's about the middle of the second premolar. This difference is too great to be due to chance in Hellman's selection of 34 out of Broadbent's 75 skulls. It is evident therefore that his technic is faulty, and tends to put the orbital plane farther back than it really is. This

*Linder and Harth also, while recording tooth breadths sometimes to .25 and .75 mm., recorded them with disproportionate frequency to .0 and .5 mm.

fact invalidates all those distributions which were obtained by the same technic, including his measurements on American Indians of various ages.

The orthodontic research worker who can pursue his investigations uninterrupted by the demands of a practice or clinic, and with adequate tools at his disposal (though this is by no means always the case in research laboratories!), has his task made much easier than that of the busy orthodontist who carries on his researches under difficulties of time and tools. All the more credit then to the latter for his achievements! But whether in laboratory or out of it, it should never be forgotten that tools must be continually tested and verified, technic must be carefully and critically studied. If one fails to detect inaccuracies in tools or technic, then the lesson will later be brought home (to those who are able to learn it) by the painful discovery of long labor wasted. I, who myself have suffered this chastening experience, have little doubt that Dr. Hellman will make good use of the wisdom thus dearly bought by us both. He may find an opportunity of remeasuring the Amerind crania and conclusively demonstrating on them the existence and extent of age changes in the relationship between the craniometric orbital point and the dental arch. Though the researches in Bonn make the existence of changes probable in this case also, one cannot assume that the extent of change will necessarily remain the same when the lowest point of the orbit is substituted for one immediately below the forward-looking pupil; when changes in the soft tissues are eliminated by working direct on the bone; when individuals with any kind of occlusion take the place of those strictly selected for correct occlusion; and, perhaps most of all, when a different race is under consideration. The extent of age changes will certainly be intimately associated with the degree of prognathism attained by the adult, whether this be measured relative to some point on the orbit or, as is more usual, to the root of the nose; and the degree of adult prognathism to be expected will largely depend upon the stock to which the individual belongs.

3. *The Orbitodental Standard and Its Application*

Though it has been demonstrated that Simon's orbital plane does not maintain the same average dental relationship at all dentition stages, that fact of itself does not involve the rejection of a standard relationship, appropriate to the age in question, as an aid in diagnosis. We have now at our disposal certain data concerning the distribution of the orbital plane in correctly occluded children during the few years after the eruption of the first permanent molar; and other data which, as far as our present information goes, are applicable to any age after the eruption of the second permanent molar. The mean position is known to within less than a millimeter for each of these stages; the limits of variation for any given proportion of the correctly occluded class can easily be ascertained. The question is, how big a proportion of these may be accepted as setting a standard? That is rather for the orthodontist to decide; the biometrician has only to remind him that, since perfect correlation does not obtain between different characters of the skull or living head, the successful achievement of what Nature apparently aims at as the ideal fit of the maxillary upon the mandibular teeth is no guarantee that she will obtain equal success in fitting the cheek bone to an ideal position (whatever that may be!) above the dental arch. It seems *a*

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priori probable that greater variability in the relationship of maxillary to mandibular dental arch will be associated with an increased range of variability in the relationship of either arch to a given point in the orbit; but at present we have no evidence as to the extent of this variation in the general population. Orbitodental observations on large unselected series—preferably drawn from the same population as has already supplied us with data for Linder and Harth's selected series—are necessary to guide us in determining how wide shall be the limits allowed our standard, if the position of the orbital plane is to figure at all among the considerations employed in diagnosis.

But the question of whether the relationship of dental arches to upper face should be taken into consideration at all, is one which seems to meet with no unanimous affirmative. As I am not in a position to discuss the questions of treatment which underlie this difference of opinion, I can only develop the argument on alternative bases.

The logical alternatives in this case are quite obvious. On the one side would be the view that the forwardness of the dental arch relative to the lower orbital rim is a factor of esthetic importance and is also modifiable by treatment; on the other side the view that the relationship is not esthetically important even if modifiable, or alternatively that treatment, even if effective, would have eventual pathologic consequences which make it undesirable. For those who may hold views under the second heading, any further consideration of "an orbitodental standard and its application" would be supererogatory and irrelevant. There is, however, one suggestion to be made in regard to the viewpoint of those who may deem the relation esthetically unimportant on the ground that some other point, not on the orbital rim, would serve better to represent the anteroposterior position of the upper part of the face as a whole. As to this, my own view would be that while some point on the profile, and preferably on the nasal bridge, would be the best *single* criterion, man's face, like man's morals, has so many different ways of departing from the ideal, that it would be best to represent it by more than one point; two at least—one on the profile and one on the cheek bone. The most posterior point on the bridge, in the median plane, and Simon's *orbitale* would probably serve as well as any. The orthodontist, having before him the verdicts of these two and his various other diagnostic criteria, would of course, as always, have to use his own judgment and experience in deciding which of the ascertained disharmonies it would be best to try to remedy. Given a large and adventurous nose and relatively receding cheek bones, it would probably be better for the mouth to be guided by the position of the nasal bridge than by that of a point related to the orbital rim; with a different nose, the orbital rim might be a better guide.

Logically the argument for the use of the orbital plane as an aid in diagnosis (if found practicable, and its position in the individual accurately determinable), or for its rejection at sight, would be covered by the above alternatives. But it is also desirable to set forth as clearly as possible the real difference of opinion which seems to determine the orthodontist's attitude to its diagnostic value. This dispute concerns the treatment to be applied if diagnosis should pronounce the maxilla relatively too far forward. Beyond restoring projecting incisors to a more vertical position (a procedure accepted by both), the one school of ortho-

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dontists has, I gather, no treatment to suggest beyond the widening of the dental arch, and whether this slackens the forward growth of the maxilla as a whole apart from any effect it may have upon the position of the teeth relative to one another, is at least questionable. The other school has a remedy to propose—extraction. The one holds that the ill-effects of extraction in damage to unerupted teeth, and/or consequent irregularity of the dental curve, and/or subsequent dental disease make it undesirable in any case. The other school considers the dangers of extraction negligible and its advantages in countering excessive forward growth of the maxilla positive; many of them also hold, I believe, that the extensive use of orthodontic appliances is itself very liable to produce dental disease later on in life. It is not for me to decide. I have only to point out that if any treatment is to be attempted—whether lateral extension or any other—as a remedy for this condition, then diagnosis must precede treatment, and any means of making diagnosis more accurate will at any rate be worth considering. Since some, at any rate, have come to the conclusion that an orbito-dental criterion would be useful, it is now my task to resume, in their interest, consideration of what this standard should be and how applied.

Supposing the range of variation in the position of the orbital plane in the general population to have been already determined, one needs to decide the limits within which it can vary without producing any serious disharmony. It might be that the limits of variation of the middle nine-tenths of the distribution would suffice; possibly a still larger proportion of the population might serve as our standard of "normality," or on the other hand we might be obliged to make the limits much more stringent. I take it that the only aspect of the orthodontist's problem which these relationships affect is the esthetic, not the functional nor pathologic. In that case composite profile silhouettes of different degrees of departure from the mean would probably be the best means of determining the limits of what might be accepted as reasonably normal. The method of working out composite profiles has already been described in detail in *Biometrika,** and the composite picture there shown of English young men and women students, absolutely unselected, is in any case well worth the orthodontist's study. Similar methods might be used to produce a type silhouette of the individuals occupying the middle half of an orbital plane distribution; and other type silhouettes of each of the two successive tenths of the population lying mesial to, and also of each lying distal to, that middle half. The remaining twentieth left at each end of the distribution would not be likely to come under the category of "normal" in any case. It is not suggested that the making of these profiles would be a quick and easy task, or one to be assigned to a worker with little sense of exactness. But the investigation of this research problem would make a more definite contribution to orthodontic knowledge than many of those others already undertaken as stepping-stone to a doctorate. Such an investigation would of course do well to note the position not only of the vertical plane through *orbitale,* but also of the vertical tangent to the nasal bridge. The material could then be classified by the two distributions in turn, and type silhouettes produced to correspond. Given these silhouettes it would probably not

*The Racial Value of Type Silhouettes, by Ida McLearn, G. M. Morant and Karl Pearson, loc. cit., XXB, p. 389, 1928.

be hard to agree upon the breadth of the category in each, whose limits should be accepted as defining "normality."

Provisionally let us use the middle nine-tenths and the middle nineteen-twentieths of the distributions for correctly occluded individuals as giving, the one a rather more stringent, and the other a more liberal, definition of normality; remembering that these same limits would most probably enclose definitely smaller proportions of the unselected population. If the distribution be Normal (or Gaussian), the distance of their respective limits from the mean will be the same mesially as distally, and will be equal in the one case to 1.65 times the standard deviation, in the other to 1.91 times the standard deviation. These distances can be easily calculated from Table III for any of the groups whose constants are given. The condition specified is that the distribution shall be Normal. Is it in fact Normal? To determine the form of a curve we need a long series. In the absence of any demonstrated real difference between Groups II and III, or between boys and girls—though this must not be taken as proving that no difference exists—we might provisionally pool our data for these four groups, and thus obtain a distribution of 93 individuals. Though this number is probably too small to indicate unambiguously the form of distribution of the population from which it is drawn, we will see what it suggests. Calculating the two statistical constants β_1 and β_2 for our pooled distribution (which as it stands is somewhat asymmetrical) we find that chance could produce from a Normal "population" a sample distribution differing from it no more than ours, about one time in five. There is therefore no necessity to assume the form of distribution to be any other than Normal. But as each one of our four component groups was observed to be slightly asymmetrical in the same direction, and as the same is also true of Broadbent's distribution of the orbital plane on an adult series,* this asymmetry may not be due to chance but to a real, though slight, asymmetry in the populations represented. It must be understood that no one of these series alone demonstrates real type asymmetry; asymmetry is far more likely in a sample from a symmetrical population than is symmetry, and the fact of the mode being on the mesial side of the mean in all these cases may be mere chance. In view, however, of the possible significance of the fact noted, the histogram (Fig. 4) representing the distribution of the 93 cases has been fitted both with the best fitting Normal curve, and the best fitting Type I_1 curve, either of which may represent the form of distribution in the population itself—assuming, of course, that we were justified in pooling Groups II and III and combining the data for boys with those for girls (increased to male dimensions). I have to thank Miss Pertia, of the Biometric Laboratory, University College, London, for the fitting of these two curves to the histogram.

To calculate the limits between which 90 per cent and 95 per cent of the population would respectively lie in the asymmetric distribution, would be a long and troublesome business owing to the inequality of the categories used in these observations; and in view of the small number of cases and consequent uncertainty as to the exact form of the curve, the time spent in calculating them would hardly be justified. It will be seen from Fig. 4 that the mode of the

*Dental Cosmos, **69**: 802, 1927. The mean tooth breadths obtained by Linder and Harth were used to plot out this distribution.

Type I_1 curve is slightly (less than a millimeter) in advance of the mean. If this curve correctly represents the distribution, the most frequent position of the maxillary dental arch relative to the cheek bone is that in which Simon's orbital plane passes through a point 2.7 mm.* behind the tip of the permanent canine; and the arch advances beyond its most usual position rather more frequently than it retreats. If the distribution be Normal, and its constants those obtained from our pooled groups, the orbital plane most frequently cuts the permanent dental arch at the point of contact of canine and premolar; in 90 per cent of correctly occluded children its position ranges from 1.25 to 11 mm. distal to the point of contact of incisor and canine; in 95 per cent, from 0.5 to 11.75 mm. behind that point. Any individuals in whom the plane is still farther forward or backward may, by these criteria, be deemed outside the normal. The corresponding values for the deciduous canine put its mean position only 1 mm. behind the tip in boys, and on the tip in the small sample of 16 girls. The mid-

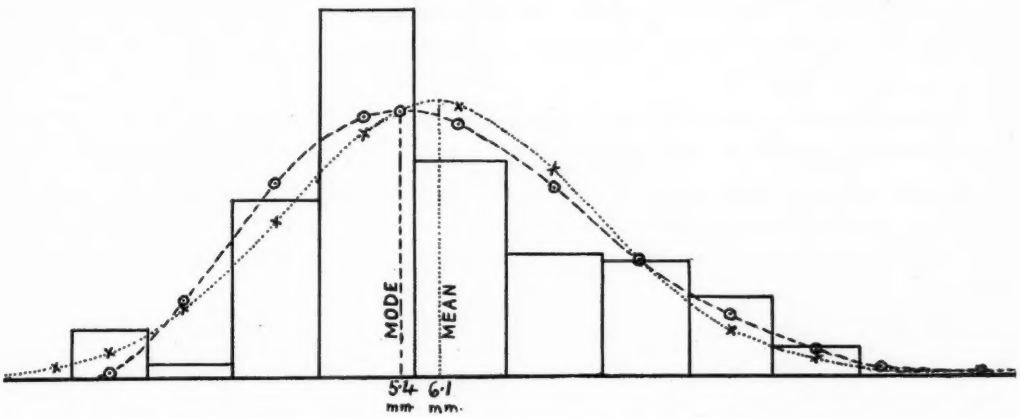

Fig. 4.—Distribution of orbital plane for ninety-three individuals, fitted with a Normal and a Type I_1 curve.

dle 90 per cent of boys, as far as a sample of 28 can tell us, would have a range of about 8 mm., from 0.5 mm. in front of |II/III to 7.5 mm. behind it. Ninety-five per cent would range from 1 mm. in front to 8 mm. behind. The range for girls would probably be about the same.

It will be realized that the standard at which we have arrived differs considerably from that proposed by Simon. It is much less rigid; and though its center point for children of five to eight years is near the canine tip, for children with a permanent dentition it is 3.5 mm. farther back. Furthermore, it is necessary, in concluding, to emphasize that exact application of this standard to diagnose individual cases must depend upon the accuracy with which the position of the plane can be determined each time. As the determination of the plane depends upon the identification of points on, or covered by, the flesh, it is likely that successive independent determinations on the same individual will not exactly coincide. Each operator must ascertain the degree of exactness with which he repeats the measurement, on say twenty or more individuals, and must allow accordingly when determining the position of the plane on his patients.

*These and the following figures must be slightly reduced (divided by 1.035) for girls.

For it would want very few millimeters of error to make the attempted application of an orbitodental standard not merely useless but misleading in diagnosis.

II. OTHER FACIAL GROWTH CHANGES

1. Changes in Relative Positions of Key Ridge and Teeth.

In addition to his observations on the position of the orbital plane Hellman has supplied us with some very interesting records of the position of the key ridge in American Indian crania classified as before into seven dentition stages. A number of crania too defective to be used for the previous investigation could now be added to the series, bringing up the total number to 160. He gives the results in a percentage distribution,* the absolute numbers for Stages I to VII being 11, 15, 17, 8, 51, 41, 17. The position of the ridge is classified according to the tooth towards which its downward prolongation leads and according to whether it arrives opposite the mesiobuccal root (MBR) of this tooth, between its buccal roots (IBR'S), opposite its distobuccal root (DBR), or opposite an interdental septum (IDS). The distribution, translated into absolute numbers, is as shown in Table IV.

The chances of getting any consecutive pair of these samples I to VII from the same "population" are shown in Table V, which gives them (under P) as a decimal part of unity, and in the succeeding column translates them roughly into the corresponding odds.

Hellman, if we interpret his definitions correctly,† divides his stages as follows:

Stage I. Early infancy: deciduous dentition incomplete.

Stage II. Late infancy: from completion of deciduous dentition to appearance of first permanent molars.

Stage III. Childhood: from eruption of first permanent molars to eruption of all the permanent incisors.

Stage IV. From eruption of permanent premolars and canines and second molars up to the beginning of the eruption of the third molars.

Stage V. Adulthood: from appearance of third molars and as long as groove patterns on occlusal molar surfaces remain distinct.

Stage VI. Old age: groove patterns on occlusal surfaces of molars obliterated by wear.

Stage VII. Senility: at least half the crown worn off such teeth as have not been lost.

Looking at Tables IV and V we see that in spite of the small number of specimens representing some of the earlier stages, they have sufficed to demonstrate indubitable differences between the positions recorded for the stages which

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*Internat. J. Orthod., Oral Surg. & Radiog. **16**: 164, Table I, 1930.

†*Loc. cit.* p. 157. The actual wording of his definitions would exclude altogether the following three classes of individuals: (a) Those with first permanent molars erupting or erupted but deciduous incisors still in place; (b) those with premolars or permanent canines erupting or erupted, but no sign of second permanent molars; (c) those who had cut their first 28 permanent teeth but had not yet produced a third molar. It seemed so improbable that there was no representative of any of the above three classes in the whole series of Amerind crania at his disposal; and so unlikely that they would be excluded before classification; that the above definitions have been framed on the only other alternative, namely that Hellman's own definitions of Stages III, IV and V were incorrectly worded. If this assumption is unjustified I apologize, but remain astonished that either of the other explanations should be correct.

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TABLE IV

DISTRIBUTION OF KEY RIDGE ON 160 AMERIND CRANIA AT DIFFERENT DENTITION STAGES (AFTER HELLMAN)

	DM^1-DM^2	DM^2			DM^2-M^1 OR PM^1-M^1	M^1			M^1-M^2	M^2	TOTALS
STAGE	IDS	MBR	IBR'S	DBR	IDS	MBR	IBR'S	DBR	IDS	MBR	
I	10	1									11
II		1	8	4	2						15
III				2	12	3					17
IV						3	4	1			8
V						8	14	18	9	2	51
VI						1	4	19	16	1	41
VII					1		3	9	3	1	17

TABLE V

CHANCES THAT DIFFERENCE BETWEEN SUCCESSIVE DISTRIBUTIONS IS DUE TO RANDOM SAMPLING ALONE

STAGES	VALUE OF P	CORRESPONDING ODDS
I and II	0.00009	About 1 in 10,000
II and III	0.00057	About 1 in 1,800
III and IV	0.00118	About 1 in 850
IV and V	0.22048	About 1 in 5
V and VI	0.01462	About 1 in 70
VI and VII	0.34570	About 1 in 3

range from early infancy to the eruption of the second permanent molars, differences which cannot possibly be ascribed to chance in sampling. We have no difficulty in seeing in these records evidence of the steady movement of the teeth forward past the key ridge until room has been found for the second permanent molar at the end of the growing queue. What happens then? Does all movement cease? Is there no further shifting to make room for the third molar when it comes? The records for Stages IV and V exhibit no difference that could not easily be accounted for by chance in sampling; but with only eight crania at one of these stages, it would be unreasonable to base on the records before us a statement that no difference exists. We can only say that it would require a longer series to demonstrate its existence.

With adulthood we should expect no further change in the relative positions of key ridge and dental arch, and look to find only such differences be-

tween the distributions of the three adult series as can easily be accounted for by chance in sampling. This is the case in regard to the records for Stages VI and VII—"old age" and "senility." But as to Stages V and VI, Table V shows us that there is only one chance in seventy that the difference between their distributions could be referred to this cause. Now while we should doubtless be very reluctant to admit the possibility of forward movement in the maxillary dental arch after the attainment of maturity, we ought also to be chary of adopting an explanation which has the odds so heavily against it if there is any other explanation possible. The only other explanation left to us in this case seems to be that the records themselves are not entirely reliable; and this drives us to examine the possible range of error in determining the relative positions of key ridge and molar roots.

The ridge runs along the outer angle of that maxillary vaulting rib which rises upward and outward to take the stress transferred from the malar bone and its flying buttress the zygoma. The ridge itself, however, even when it is a ridge and not a mere curve which allows latitude in determining where the key ridge would be if it were there at all—rarely descends as far as the alveolar border but becomes merged in the general lateral curvature of the maxilla. Careful examination of a considerable number of skulls from this point of view persuades me that there is room for individual variation in identifying the exact line of the ridge itself in many cases; and in most cases there is room for variation in determining the exact course along which it shall be prolonged to the alveolar border. These two possibilities of error would frequently render it impossible to record correctly the position of this prolongation of the key ridge within such narrow limits as the breadth of a molar root or of the space between two roots. The conclusion is, therefore, that the difference between the distributions for Stages V and VI may be ascribed to the unreliability of the records, due to the selection of a character which it is not possible to classify accurately in such small categories.

In any case the odds are 69 to 1 that we have to choose between this explanation and admitting a forward growth of the dental arch in middle life. It would not be difficult to test the truth of my conclusion. Let two or more observers record independently the position of the key ridge in the MBR, IDR'S, DBR and IDS categories used above, on 50 or more skulls (preferably young and old mixed), being careful to make no mark on the skull; and then see how the results compare. If they do not tally, let them try half tooth, or if necessary even whole tooth categories, to find within what limits its position can be definitely recorded. Let the several observers who have published records of key ridge positions each carry through the same process himself twice over on 50 skulls, if he can trust his memory to retain no records of the first series of determinations, and make known the results, so that they, and we, may know certainly how far their distributions may be accepted as exact. Until doubt on this point is resolved, we must remember that, though in comparing the distributions for Stages I to IV we discounted the effects of random sampling, we did not allow for any uncertainty that may attach to the recorded positions of the key ridge. But whether or not the details of the picture prove to be exact, there is

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little doubt, I think, that we may rely upon the general outline of the events which it depicts.

2. Changes in Relative Positions of Auricular Axis, Nasion, Upper and Lower Prosthion, Menton and Gonion.

Suggestive studies of the growth changes in relative position of the above six points projected on to the median plane have been made by Hellman on those more complete Amerind crania which were used for recording the position of the orbital plane, and were 7, 9, 17, 10, 20, 22 and 18 in number at Stages I to VII respectively. Radial measurements were taken from the auricular axis to four points in the median plane—at the root of the nose, on the maxillary and

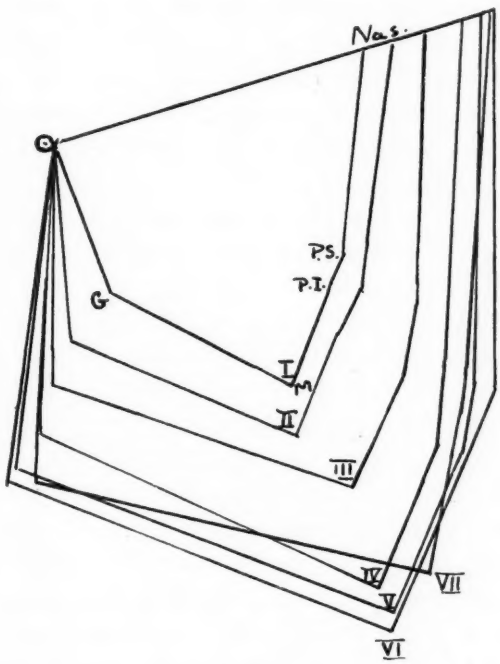

Fig. 5.

mandibular alveolar arches, and on the tip of the chin; also to the angle of the jaw (whether left or right is not specified) as projected on to the median plane. Measurements were also made from each point to the next in this sequence, and from the root of the nose to the chin tip. These various lengths were then averaged for each dentition stage, and the respective means used to construct a series of irregular pentagons each with three chords radiating from the ear point and one chord from nasion to menton.* The pentagons were then superposed (the chords used in construction being omitted from the finished figures) with their ear points coinciding and auriculonasion lines coinciding in direction.

Facial diagrams thus constructed afford a very good means of comparing

*To construct the pentagon three chords only are required, not four; Hellman states that he used the chord giving nasion-menton distance (face-length), so one of the chords to upper and lower prosthion would be omitted in construction.

the facial proportions of different groups, or of different individuals. Hellman's superposed mean diagrams for Stages I to VII are reproduced in Fig. 5*; and, as it may also be of some interest to compare the different proportions apart from the difference in absolute size, the first six of Hellman's pentagons are shown in Fig. 6 all reduced to the scale of the ear nasion length: the seventh, which shows considerable change in the position of the mandible owing to loss of teeth, has been omitted from Fig. 6.

These diagrams bring out very effectively the general pattern of growth change. Of course in comparing the successive profiles we must bear in mind the number of instances on which each is based. Nor must we forget that, even

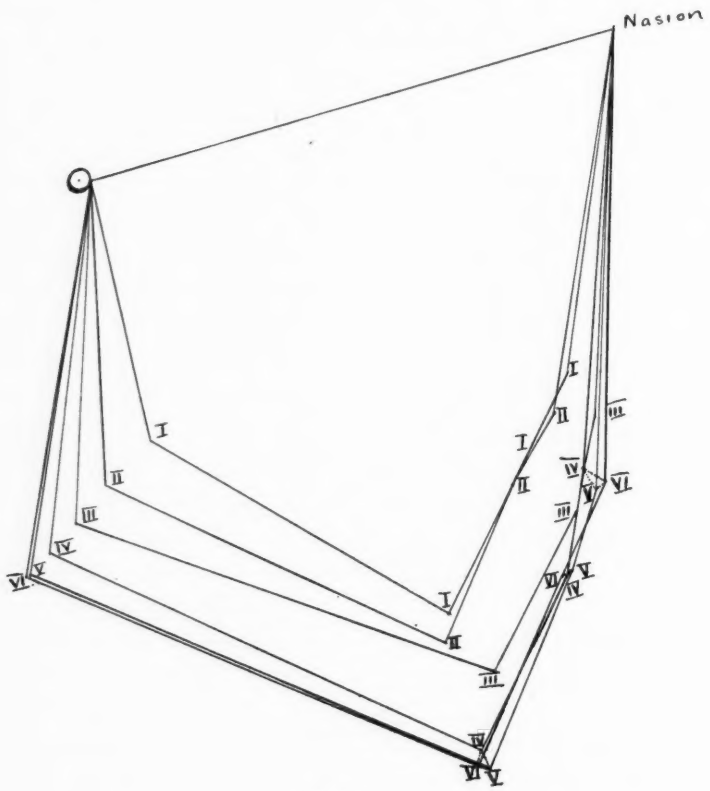

Fig. 6.

were each based on a very large sample, with mixed sexes such as we have here, the dimensions of the pentagons will also depend on the proportion of males to females—and we have no guarantee that all the groups were mixed in the same proportions. With these provisos in mind let us examine Figs. 5 and 6 in detail.

To begin with the older stages, the very close correspondence between Stages V and VI (younger and older adults) not only indicates the practical absence of bone change that we should expect between these stages but, by their confirmation of each other, gives us confidence that in this case about 20 crania (20 for Stage V, 22 for Stage VI) have sufficed to provide a close approximation

*Internat. J. Orthod., Oral Surg. & Radiog. Fig. 14, **16**: 165, 1930.

to the mean proportions of the much larger mixed adult population of which they are samples. Looking now at pentagon IV representing children ranging in age from about ten to seventeen years or more, we find that the difference in size compared with that of the adult, as seen in Fig. 5, also agrees quite well with general observation. But is the variation in *proportion*, as shown in Fig. 6, altogether to be relied upon? It *may* accurately reflect the facts; and yet when we compare in Fig. 6 pentagon III based on 17 skulls (aged about five to nine years) with the adult pentagons, we should expect a priori, to find the adolescents intermediate in shape. This is the case in regard to the angle of the jaw, but not in the face as this sample would have it. As, however, the sample amounts only to 10 specimens, chance in sampling would doubtless be quite enough to account for the divergence of pentagon IV from its expected position between pentagons III and V. In view of the small numbers on which it is based we shall not rely too heavily on the details of its shape. Pentagon III, being based on 17 specimens, is likely to represent with somewhat greater accuracy the facial proportions of its dentition stage. In regard to pentagons I and II (aged roughly under two and about two to five years), these are based on 7 and 9 crania respectively, and therefore, though they represent well enough the great difference between infant and adult proportions, cannot be trusted to reflect accurately the changes which take place from earlier to later infancy.

3. Hellman's Norm

The practical use to which the orthodontist will need to put such diagrams representing the average of a series, is as a test of the "normality" of the individual case. Hellman has in this matter taken a signal step in advance of other orthodontists up to that time, though Korkhaus has since followed him. He has taken as his standard, or norm, not the mean, but the range probably occupied by the middle 68 per cent of the population from which his sample was drawn, or in other words, the limits of the standard deviation of his sample. This is a most sound innovation, though his limits are perhaps rather stringent. The statistician, in working on various kinds of data, is used to regarding as "abnormal" those extremes which compose about one twenty-second of the population, or less. But there is no point which definitely divides "normal" from "abnormal" from the theoretical standpoint; and if the orthodontist decides for various reasons that nearly one-third of the unselected population lies without the pale, he may perhaps be justified. Given type silhouettes such as have already been suggested, it would be more possible to come to a definite conclusion on this point.

4. Application of Norm to Face Diagrams

Hellman has represented the range occupied by the face diagrams of the middle 68 per cent of the population as follows. Having worked out the standard deviations of all the measurements used in the construction of his face diagrams (this was done on a series of adult skulls long enough to give reliable standard deviations), he constructs and superposes in the manner described above, three pentagons, one formed from the mean lengths of the various measurements; another, falling within it, from the mean lengths *minus* the respective

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standard deviations; the third and largest, from the means *plus* the standard deviations. The space between the outer and the innermost pentagons is then shaded in; and since the shaded area is enclosed within lines which connect the upper and lower limits of the selected "norm" for each measurement, this same shaded area is taken to be the locus of the face diagrams of the middle two-thirds of the population. Hellman diagnoses individual profiles by the extent to which any one of their terminal points falls outside the shaded area, when superposed on such a diagram.

This attempt to create a statistically sound and readily applicable standard by which to diagnose abnormalities in that complex and variable structure, the face, is ingenious and would be very good, except, alas, for certain statistical snags in the argument that are extremely easy to overlook. It is a pity that some such diagram cannot be used as proposed, but the matter is more complicated than at first appears. What Hellman's shaded area gives is the limits between which the profiles of the middle two-thirds would lie *if* there were perfect correlation between all the face dimensions used in constructing such a diagram. Perfect correlation would exist if, when one dimension was less than its mean value by the amount of its standard deviation, all the other dimensions were similarly less than their own means by the amount of their own respective standard deviations; and similarly, if, when one dimension exceeded its mean value by four-fifths, eleven-tenths, twice, or any other given proportion of its standard deviation, all the other dimensions exceeded their mean values by exactly the same proportion of their own standard deviations. Now where you get perfect correlation, you get what is termed a cause and effect relationship—but never in any group is this relationship found to exist between the proportions of the face, nor, for that matter, of any other part of the body!

Given perfect correlation, the limits of variation of the several points in the profiles of the middle 68 per cent of the population can be indicated more exactly than by shading in the whole area between Hellman's smallest and largest pentagons. I have copied his diagram for adult American Indians and added to it certain other lines (see Fig. 7). The little curved finely dotted lines running across all the corners of the set of pentagons represent the paths along which—given perfect correlation—the terminals of our measurements would always lie as long as deviations from the mean values did not exceed the standard deviations. These curved lines completely represent the range of variability in our pentagon in such circumstances: it is not necessary to retain the outlines of the pentagons any more than it was necessary for Hellman to retain the chords, once his figure was constructed.

Let us now see what is the range of variation for these points when perfect correlation does not exist—as indeed it does not. The little irregular lozenges which I have inserted in Fig. 7 represent the loci of our terminal points when no line may vary from its mean length by more than its standard deviation, but when they are not bound to vary in chorus. Incidentally, one could make quite hideous and impossible profiles by travelling from one to another of these loci and always keeping within the prescribed limits of variation for each individual dimension.

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Now let us get some idea of how big a proportion of the population we might expect to find within these limits. Given perfect correlation the terminal points for 0.68 of the population will, as we have seen, be crowded onto the small curved lines across the "corners" of Fig. 7. Given complete absence of correlation the terminal points of about one twenty-fifth of the population would lie within the lozenges, and the remainder outside. Neither of these conditions holds good but something intermediate to them. The exact degree of correlation between the different pairs of dimensions has still to be ascertained. The higher the correlation the greater the proportion of terminal points that would crowd into the lozenges, gradually converging upon the curves across the "corners" until, if perfect correlation were realizable, the proportion which Hellman accepts as normal would be found perched upon those short curves, and the 32 per cent who were outsiders would occupy the extensions of those same curves within and without his shaded enclosure.

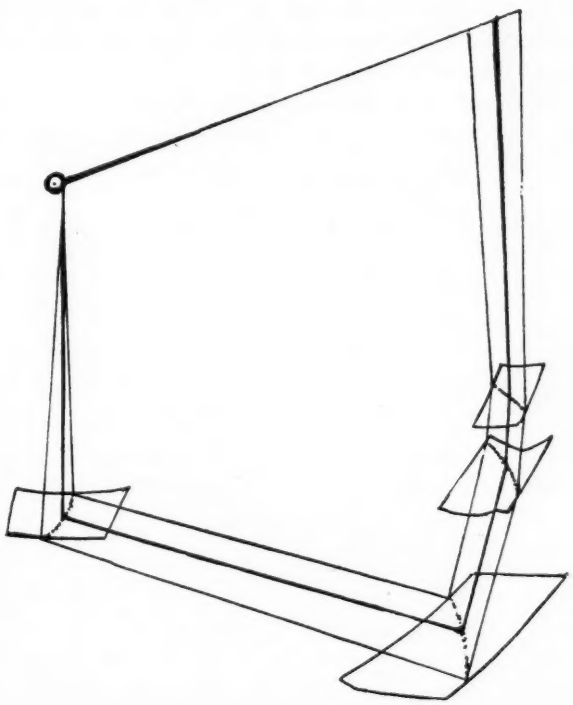

Fig. 7.—Hellman's set of pentagons for adult Amerinds, to which are added loci or facial points when all individual dimensions lie within the limits of their standard deviations (1) given perfect correlation (curved lines across corners), (2) given no correlation (irregular lozenges).

Let us now see how a norm fixed by the limits which confine a given proportion of a "population" can be applied in practice in conjunction with Hellman's face diagrams. As we have seen, the range of the distribution of this middle section of the population about any of the variable points in the diagram depends upon the degree of correlation between the different dimensions. The first requisite therefore is accurate measurement of the various lengths on an adequately large sample of the appropriate sex-age-group of the appropriate

population. To get a norm applicable to children dealt with in a Bonn clinic, for example, a random sample of Bonn children irrespective of inquiries into racial origin, would probably suit the purpose very well. In New York, where the racial components are much more varied and less blended, it would be desirable to obtain separate standard profiles for various racial groups that exist there largely unmixed as yet with other stock (Jews, Italians, etc.) though the clinician would certainly want a standard "mixed European" profile too. The measurements having been obtained, the competent statistician whose collaboration is required in any such investigation would work out various statistical "constants" which should include the coefficients of correlation between all these lengths taken in pairs. He would not only draw the mean profile diagrams but also draw up a chart giving the limits between which, given a specified length for measurement *A*, measurements *B*, *C*, *D*, etc., will vary in (a) the

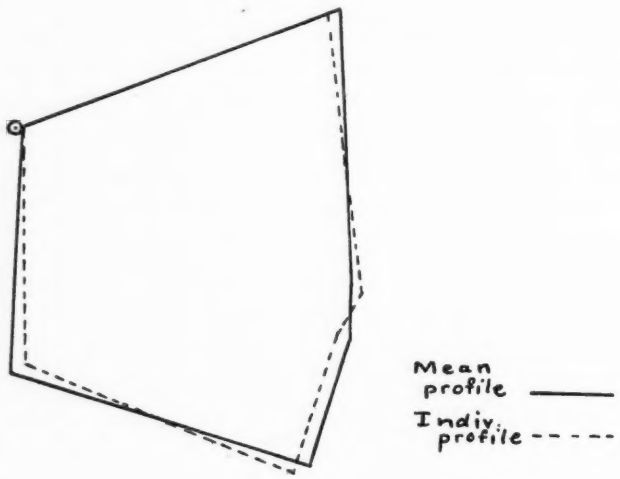

Fig. 8.

middle 68 per cent, (b) the middle 90 per cent of cases; and similarly for given lengths of *B*, *C*, *D*, etc. Provided with the mean profile and the chart, the orthodontist superposes on the former a profile of an individual case which he wishes to diagnose. In Fig. 8 one such profile is shown superposed on Hellman's adult Amerind profile.

In this case of Class II malocclusion, none of the points would fall outside the shaded area of Hellman's diagram, but disharmony is obvious. Where does the greatest fault lie? The first consideration is, I think, what would be the most appropriate standard of size by which to judge this face. In length from nasion to upper prosthion, and lower prosthion to chin, it is longer than average, and in this the distance of upper prosthion from ear point agrees with it; but from the ear point to nasion, to lower prosthion and to menton, it is below the average, and so also are the two lengths that meet at the angle of the jaw. As it is more important to have the anteroposterior measurements in harmony, one might provisionally select the length from ear point to nasion as setting the standard of size, and consult the chart to see what would be the range in length

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from ear point to upper prosthion for 68 per cent and 90 per cent of people having the given auriculonasion length; and similarly to find the range of auriculo-lower-prosthion length, and ear chin length. We should probably find that the auriculo-upper-prosthion length falls outside the normal range (judged by the more stringent standard, and probably also judged by the more liberal one) for these persons, and that the measurements from ear to lower prosthion and to chin fall within their respective limits of normality. In that case, it is the maxilla that disturbs the general picture and protrudes too far relative to the others, though not perhaps relative to the type profile of the population. Supposing the whole mandible were shifted forward. Then, though the three points on the jaws would be more in harmony, the lower part of the face would probably seem to protrude by comparison with the upper part (unless the individual had a large and salient nose, in which case it might be well, from the esthetic standpoint, to advance the jaws a little towards keeping it company). In any case, however, it is not for me to suggest what the treatment should be—only to show how diagrams such as Hellman has suggested could be used, together with a chart, in the diagnosis of facial disharmony.

5. *Changes in Relative Anteroposterior Positions of Zygomaxillare and Molare*

Investigations into the relative positions of the above points, left and right, form part of a considerable work by Prof. A. Oppenheim, published in *Zeitschrift für Stomatologie* (**25**: Heft 6, 1927, and **28**: Heft 4, 1930). The 1927 paper was subsequently published in an English translation in *Dental Cosmos* (**65**: 1928) with certain omissions. As these included the larger table of results (one of the most valuable parts of any report on biometric investigations), Prof. Oppenheim very courteously supplied me with off-prints of the original papers for the purpose of this critical analysis.

Zygomaxillare is defined as the lowest point in the zygomaxillary suture when the skull is orientated to the Frankfort plane*; *molare* marks the middle of the occlusal surface of the maxillary first permanent molar.† Oppenheim's investigations into age changes were carried out on a series of 84 crania exhibiting correct occlusion and ranging in age from about six to twenty-five years. Sex and race are not mentioned, and one must again remind those who may be carrying out future investigations that both these factors are likely to affect the measurements they record, and should be taken into consideration both by the investigator and by the student of his researches. In dealing with immature crania the liability to error in determining sex is considerably greater than with adult crania (and determining the sex of a series of the latter will not be correct in every instance), so that it is probably just as well to keep the sexes together in this case where no independent record of sex is available—but the fact needs to be mentioned and borne in mind as qualifying the reliability of one's results. In dealing with living children the sexes should be kept separate. We shall doubtless be correct in assuming that Oppenheim's crania were of both sexes. As to race, in default of information to the contrary we can only assume that this too was probably very much mixed, though comments elsewhere in his

*Dental Cosmos, **70**: 1100; Ztschr. f. Stomatol. **25**: p. 12 of off-print.
†Loc. cit. Dental Cosmos 1102; Ztschr. f. Stomatol. 13.

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paper suggest that the series would be likely to include only representatives of races in which prognathism was rare. With the mixture limited to orthognathous races (though one must not eliminate any prognathous *individuals* they may include and thus abandon random sampling for selection), it is probable that racial differences in the relative positions of *zygomaxillare* and *molare* would also be sufficiently reduced to prevent their masking entirely those age changes which it is desired to study.

The anteroposterior relationships of *zygomaxillare* and *molare* were measured by Oppenheim in two different ways. In the first, he oriented the cranium on Ranke's craniostat to the Frankfort plane, making the latter vertical instead of horizontal. This can be done quite accurately, though one must of course see to it that the suborbital point lies vertically above the porion and not vertically above the center of the ear rod. With the cranium thus up-ended, one has merely to measure with a stativgoniometer the respective heights of *molare* and *zygomaxillare* above the porion, in order to get their anteroposterior distances therefrom when the cranium is in the normal Frankfort position. Oppenheim does not give us any measurements for different age groups by this perfectly good and straightforward technic, but he does mention that those obtained by his second technic did not always tally with them: "In view of the difference between the two methods used in determining the relationship of *molare* to *zygomaxillare* it is very easily possible to get differences (though small ones) in the results, especially in regard to the *absolute* differences between the two distances ba – zyg′ and ba – mo‴* (that is, the respective distances of *zygomaxillare* and *molare* in front of the basion, as measured by the second method). He goes on, however, to state that it is not their absolute distances from the transverse vertical through the basion, but simply the proportion between them that it is desired to establish; and that this can be obtained correctly from the index.

$$\frac{100\ (\text{ba} - \text{zyg}')}{(\text{ba} - \text{mo}'')}.$$

Let us examine this second technic and satisfy ourselves as to the reliability of the index it produces.

The second technic is more complicated than the first, and is based on two assumptions. The first is that there is only negligible asymmetry in correctly occluded crania; the second, that the line joining basion to the point midway between the two *zygomaxillaria* having been observed to have a maximum inclination of about 5° to the Frankfort horizontal through the basion, and its mean position to be practically coincident with the plane itself, measurement of the anteroposterior positions of *zygomaxillare* and *molare* along this line will give lengths that may not differ from each other by the same amount as the corresponding measurements parallel to the Frankfort plane, but will nevertheless maintain the same proportion one to the other.

To deal with this second assumption first: if from any two points, perpendiculars be dropped onto each of two radii of a circle, and the distances be measured between the feet of all these perpendiculars respectively and the center of the

*Ztschr. f. Stomatol. **25**: 1927, p. 17 of off-print.

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circle; then *neither* will the difference between these two distances on the one radius equal the corresponding difference on the other, *nor* (unless the two points in question lie along a third radius) will the proportion between the two distances along the one radius be equal to the corresponding proportion on the other. Applying the above geometrical statement (whose truth can easily be tested by drawing such a figure and measuring the lines) to the case in point: the basion is in the center from which we have two radii, one parallel to the Frankfort plane, one uniting basion to zyg′ (the point midway between the *zygomaxillaria*). The position of the two points referred to in our geometrical statement is not limited except by the condition that they must not lie on the same radius of the circle—and as basion, zyg′, and mo′ (midway between the *molaria*) never do lie in the same straight line, this condition is fulfilled. There is nothing in the above general statement to prevent either of them being on one of the radii concerned: when this happens the length of the perpendicular uniting point and radius becomes equal to nought, and the distance from its foot to the center of the circle equals the distance from the point itself to the center. In the case in question we have the point zyg′ on the radius ba – zyg′, and the point mo′ not on this radius, though it may be on the radius representing the horizontal. The difference between the distances of zyg′ and mo′ from basion will be *less* when projected onto ba – zyg′ than when projected onto the horizontal through the basion (whether zyg′ be above or below the latter); and the greater the angle between ba – zyg′ and the horizontal the greater will be the effect on the absolute difference. This agrees with Oppenheim's observation of noncorrespondence. Neither will the index of the one distance over the other be the same for projections on ba – zyg′ as for projections on the horizontal: it will be *greater* on ba – zyg′; and—though the change is not so rapid as the increase in absolute difference—the greater the angle between ba – zyg′ and the horizontal, the greater becomes the difference between the two indices. This disagrees with Oppenheim's assumption of correspondence.

Let us now consider the first of Oppenheim's assumptions in applying the technic by which he obtained his published results, namely, that "the small asymmetries of skulls having completely normal occlusion may be neglected."* Now although a priori one might assume that asymmetry in the position of the first molars would on an average probably be less in correctly occluded crania than in unselected, and perhaps that asymmetry in the position of the lowest points in the two zygomaxillary sutures might also be reduced though to a less extent, it is hardly safe to assume that the degree of asymmetry in these two respects would be negligible. For one thing the various characters of the skull are not so very highly correlated that "perfection" in one respect guarantees practical perfection in all. Second, even if one assumes the type skull (that is a skull corresponding in all respects with the mean) to be perfectly symmetrical, although differences between direct measurements, right or left, would then cancel out on a long series, mathematical theory does not support the expectation that even on a long series functions of those measurements would thus cancel out (and Oppenheim's calculated distances are functions of his direct meas-

*Ztschr. f. Stomatol. **25**: 1927, p. 14 of offprint.

urements). Still less would this be the case in small groups. Third, the assumption of symmetry in the type skull is not justified. This has recently been demonstrated by Dr. T. L. Woo, by actual and accurate measurement of a series of nearly nine hundred late dynastic Egyptian male crania. Twenty-five characters were measured on homologous bones of the cranium, left and right; and two of the conclusions of this very thorough and exact study may be quoted here:

"(1) The human skull is definitely and markedly asymmetrical. It is not a question of the bones of individual crania differing from a symmetrical type, but the type cranium itself is asymmetrical. (2) Some dimensions of the cranial bones have dominance on the right side, some on the left, but on the whole the right side for size has dominance over the left. This is especially true for the frontal and parietal bones; the malar bone is the only case in which the left side has dominance for all measurements taken, and this bone has less relation to brain development."*

In view of the lack of symmetry in the type and the certainty of asymmetry in many individual crania, we must endeavor to see just how the position of Oppenheim's planes of reference will be affected by asymmetry in the individual skull. As we have already seen, the direction in which he measures anteroposterior position is determined by the direction of the line joining basion to a point (zyg′) which will lie midway between the two zygomaxillaria when the latter are symmetrically placed in relation to the basion prosthion line. Oppenheim's median plane passes through basion, prosthion and zyg′; his horizontal through basion and zyg′, at right angles to the median plane. The line ba – zyg′ lies in both median and horizontal planes and as the point zyg′ moves, the planes of reference move accordingly. Oppenheim has determined the position of zyg′ by constructing an isosceles triangle whose two sides are each equal in length to the distance between basion and R. *zygomaxillare,* and its base equal to the distance R. zyg – L. zyg. The apex represents the basion, and in skulls whose *zygomaxillaria* are equidistant from basion, this triangle correctly represents the relative positions of the above three points; a perpendicular (ba – zyg′) from basion to base will bisect the latter; the line R. zyg – zyg′ will be equal to half the distance between the *zygomaxillaria,* and also perpendicular to ba – zyg′, being at the same time perpendicular to the median plane which passes through basion, prosthion, and zyg′.

Oppenheim has assumed that also the *molaria* may be regarded as symmetrically placed with regard to the line ba – pros, and also (a condition not necessarily involved by the first) symmetrically with regard to the two *zygomaxillaria.* The point which, in skulls obeying the first condition, will lie midway between the two *molaria* is termed mo′; and by imposing the second condition also one ensures that mo′ will lie within the median plane determined by basion, prosthion, and zyg′. We then have in this plane the projective distance of *zygomaxillaria* from basion, measured along the line ba – zyg′, and the projective distance of *molaria* measured along the line ba – mo′. To transfer the latter to the planes of reference determined by the position of zyg′, we project the line ba – mo′ upon ba – zyg′ or upon ba – zyg′ continued, according as the perpendicu-

*Biometrika, **22**: 339-340, 1931.

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lar from mo′ falls behind or in front of zyg′. The point where it meets this line is called mo″; and ba – mo″ measures the anteroposterior position of the *molaria* relative to a horizontal through ba and zyg′, and ba – zyg′ measures the corresponding anteroposterior position of the *zygomaxillaria*. From this Oppenheim obtains the index $\frac{100 \times \text{ba} - \text{zyg}'}{\text{ba} - \text{mo}''}$ as a measure of the relative forwardness of the two features.

Let us now see what happens to the planes of reference when the symmetry of the two *zygomaxillaria* about the ba – pros line is destroyed by the various possible modifications in the position of these two homologous points, basion and prosthion remaining fixed. We shall call the symmetrical position *A*.

(1) Starting with position *A* let us first imagine R. zyg moving a little nearer to L. zyg, but keeping along the line which joined them (thus incidentally shortening the distance of R. zyg from both ba and pros). The point zyg′, in order to make the line R. zyg – zyg′ equal to half the distance between R. zyg and L. zyg, must now move nearer to L. zyg; we must thereupon tilt the median plane a little to the left to enable it to pass through zyg′. But R. zyg – zyg′ is now no longer perpendicular to the median plane, and must push the plane still farther over to the left in order to have room to get into the correct position. Our first modification of position *A* has thus resulted in a double tilt of the median plane over to the left.

(2) Under the same condition as laid down in (1), let L. zyg move nearer to R. zyg along the line R. zyg – L. zyg. The midpoint zyg′ must now move to the right, and the median plane in following it be tilted also to the right. The line R. zyg – zyg′ in struggling into a position perpendicular to the plane must push the latter back toward the left. These two moves are thus in opposite directions, and the plane returns to somewhere near its original position *A*.

(3) Let us now abandon the condition that the movement of R. zyg or L. zyg must be along the line joining them in position *A*; either of them can move up or down, backward or forward, and if in so doing they remain equally distant from the original position of zyg′, the only adjustment necessary is for the median plane to be tilted as much to the left as is necessary in order to enable R. zyg – zyg′ to get again into the perpendicular position. If, however, they have not remained equidistant from the original position of zyg′, this point has first had to move to right or left, the median plane has had to follow it. If the tilting of the plane to left or right redresses the departure of R. zyg – zyg′ from perpendicularity, the plane then remains as it is; if on the other hand its tilt has brought R. zyg – zyg′ still further out of perpendicular, the latter will need to give it so to speak a *double* push over to the left in order to adjust itself.

We thus see that as Oppenheim's "median plane" rotates about the basion prosthion axis in adjusting itself to conditions of zygomaxillary asymmetry, it will most often remain tilted well over to the left, though it sometimes returns to approximately where it was, and will more rarely be found tilted a little to the right. Thus its most frequent position, in the very common case of asymmetry, is in no sense median.

The corresponding positions of zyg′ will be: below the level of R. zyg and to the left of the median of zygomaxillary symmetry, when the "median plane" is swung over to the left; above the level of R. zyg and to the right of the aforesaid

median in the rarer cases of a tilt to the right. Zygomaxillary asymmetry thus has a tendency to tilt ba – zyg′ further upward, though it may operate to tilt it downward. How does this react upon Oppenheim's index? We have seen that any inclination of ba – zyg′ to the Frankfort, whether by zyg′ being below or above the level of basion, tends to increase the value of his index. Oppenheim tells us the maximum inclination to the horizontal of the plane passing through basion and the *zygomaxillaria,* namely 5°: he does not tell us specifically whether the plane reaches this maximum both above and below the horizontal through the basion. If the mean position of this plane be either in or above the horizontal through the basion, the effect of asymmetry in tending to raise the line ba – zyg′ will bring the maximum inclination of ba – zyg′ to more than 5° above the horizontal. But in any case, wherever the mean position of the basio-zygomaxillary plane, asymmetry will widen the limits of variation of ba – zyg′ relative to the horizontal, unless—what is extremely improbable—there should be a considerable negative correlation between degree of asymmetry and the height of *zygomaxillaria* above the level of the basion. The net effect of zygomaxillary asymmetry—even if we assume that the *molaria* remain symmetrical with regard to the latter—will thus be a further distortion of Oppenheim's index from the true. It is unnecessary at this point to examine in detail the effect of asymmetry in the position of *molaria,* since it follows somewhat the same course towards a conclusion that this too will help to impair the accuracy of Oppenheim's index.

Our analysis of the technic by which the published results were obtained has shown that in any further work on the characters in question the technic first used by Oppenheim, that of direct measurement on the craniostat, will be preferable, in order that one may refrain from adding any avoidable distortion, however slight, to the unavoidable effects of chance in sampling. The extent of the distortion, however, is as yet unknown. The inaccuracies inherent in his second technic may have failed altogether to mask the growth changes which it was designed to record: they may have been quite small in comparison with the latter. As in any case it is not obvious that their probable effect would be different at different ages, we may hope that at most they will have contributed a stagger to the progress of the index from its six-year to its twenty-five-year value over and above that for which the smallness of the samples (and perhaps also race mixture*) would have been responsible. In any case let us see.

The results omitted from the *Dental Cosmos,* but given in full in the *Zeitschrift für Stomatologie* (**25**: pp. 18-24 of offprint) are plotted in Fig. 9. The unlinked dots in this figure give the means as found by Oppenheim; the linked dots give the results obtained when his errors in working out the averages are corrected.† In this diagram, although the index tacks somewhat, its general

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*As to the mixing of the sexes, this may have no effect upon the index, for while it is certain that there is a difference of *size* between boys and girls, there may be no difference of *shape* as far as it would affect this index.

†Nonstatisticians are very liable to underestimate human proneness to error in making simple arithmetical calculations and in consequence often fail to realize that not only all calculations but also all copying of figures must be checked. More experienced calculators always do this, and even so do not find it an absolute guarantee against occasional slips.

Also it is often forgotten that it is more accurate to reckon everything over a half as a whole, than to omit it altogether. Thus 107.63 in whole numbers, would be 108, while 107.47 would be 107; reckoned to the first place of decimals they would be 107.6 and 107.5 respectively. Oppenheim has forgotten this, and usually omits anything over a whole number.

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course as age increases is clearly upward: that is, the center of the occlusal surface of the first permanent molar, which in young children is farther back than the lowest point of the zygomaxillary suture, grows forward more rapidly than the latter. It tends to catch up at about the age of nineteen or twenty years, and its *mean* position from that age is probably stable, with *molare* slightly in front of *zygomaxillare*. The mean value of Oppenheim's index

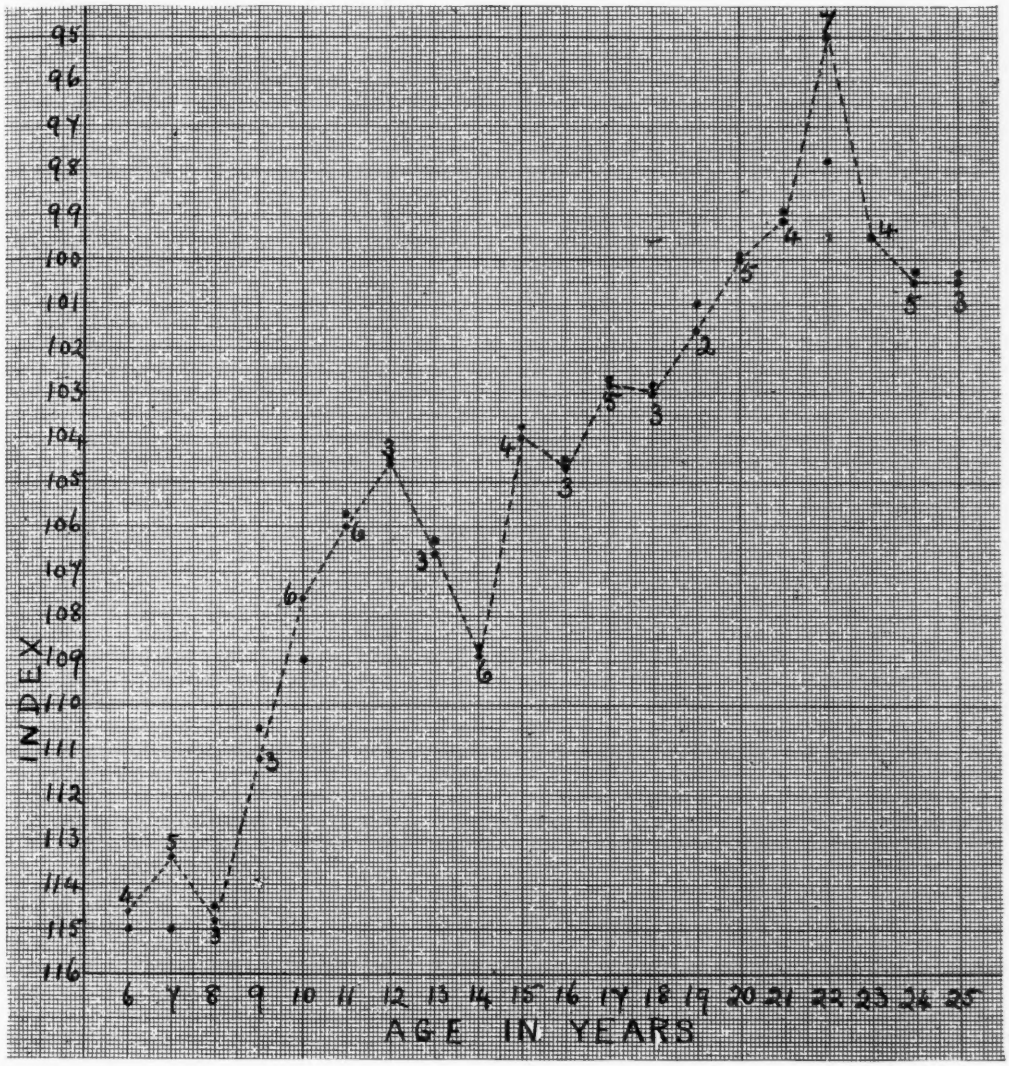

Fig. 9.—Oppenheim's distribution of the index $\frac{100 \times ba - zyg'}{ba - mo''}$ corrected and uncorrected (dotted line links corrected means). Figures give number of cases for each year of age.

for 28 individuals aged twenty years and over is 98.7, but as we have found that the inaccuracies inherent in his technic would tend, on balance, to increase the index, the mean position of *molare* in the adult is probably rather farther in advance of *zygomaxillare* than Fig. 9 indicates.

With this demonstration of age change in the relative positions of points on the malar bone and dental arch, Oppenheim provided strong presumptive evi-

dence in favor of his main contention, namely, that the relative anteroposterior positions of Simon's cephalometric *orbitale* and the canine tip would not remain unaffected by growth from five years old to forty.

6. *Growth Changes in the Porion Orbitale Canine Angle*

Oppenheim followed up his study of the forward growth of the first permanent molar, by measurements of the angle between the straight lines uniting porion and canine tip to the lowest point on the rim of the orbit, on 79 of the 84 correctly occluded crania (of various ages) used in the previous investigation.

The procedure was as follows: the distances between porion and *orbitale*, *orbitale* and canine tip, canine tip and porion, were measured with the calipers; the triangle was then reconstructed on paper, and the angle at *orbitale* measured with a protractor. The angles of the reconstructed triangle would of course be exactly the same as the corresponding angles on the skull, given accurate measurement, and the only uncertainty that might then qualify the result would depend upon the choice of lateral position for *orbitale*. Its vertical position is not difficult to determine and is usually the only one that matters, but the gentle curve of the lower rim of the orbit may give a possible range of several millimeters to the "lowest point," and since the angle under consideration does not lie in a sagittal plane but in one that combines a lateral with a forward direction, the size of the angle will be affected by the exact lateral position of its apex. Any discrepancies between two independent measurements of the angle in individual skulls would, however, tend to cancel out in averaging a considerable series, though they may affect the mean values obtained for the small groups of two to seven crania which represent each year of age from six to twenty-five in Oppenheim's series. His means were given in the table omitted from *Dental Cosmos,* and are represented graphically in the first section of Fig. 10. His comment on these results is that on the whole the angle increases with increasing age; but in truth the means as he gives them do not bring out this fact very obviously! When, however, we correct the arithmetical errors in averaging, and plot the corrected means as in the second section of Fig. 10, their general drift becomes more apparent; and when by pooling several age groups we reduce the erratic features of the distribution caused by the smallness of the samples, we get in the third section of our figure a still clearer picture of the association between age and size of angle.

Oppenheim's application of these results to the question of the relative positions of canine and the transverse vertical plane through Simon's *orbitale* is, however, not quite sound. He says: "To go more closely into the criticism of Simon's teaching, we will take, instead of the linear distance of canine tip from orbital plane, the porion-*orbitale*-canine angle that we have constructed, guided by the assumption that the size of the porion-*orbitale*-canine angle must remain the same throughout life if, as Simon maintains, the relationship between orbital plane and canine remains constant from the fifth to the fortieth year."* Surely growth in cranial breadth can also operate to open out the arms of this angle, reaching as they do from in front not only backward but also considerably

*Dental Cosmos, **70**: p. 1107; Ztschr. f. Stomatol. p. 24 of offprint.

outward. Oppenheim's assumption that his angle will necessarily remain the same as long as Simon's anteroposterior relationship remains the same is, therefore, not justified. His angle measures the effect of forward and lateral growth combined. While in view of previous findings we shall not be tempted to at-

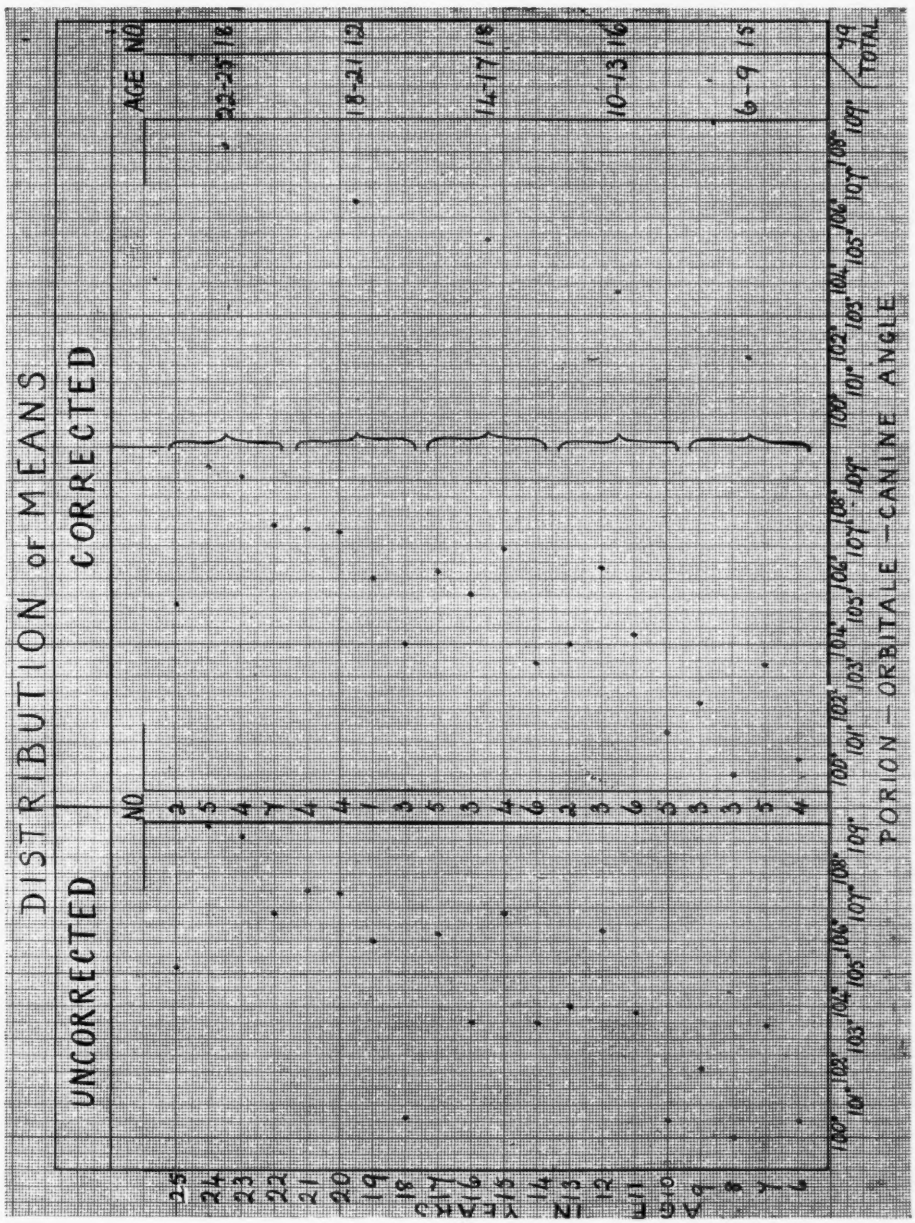

Fig. 10.—Distribution of porion-orbitale-canine angle (after Oppenheim).

tribute the increase in the angle to lateral growth alone or even mainly, in itself it provides no conclusive evidence in refutation of Simon's theory.

7. *Projective Tooth Breadths at Different Stages of Growth*

Linder and Harth, in the course of researches already described, performed the great service of measuring the breadths of the teeth that they and others have

used as a scale on which to register the anteroposterior position of other facial characters. They have given us the breadths, as projected on to the median plane, of the points of contact of successive teeth (or the midpoints of spaces between them) from lateral incisor to first permanent molar; also the position of the tip of canine cusp, and the tips of premolar cusps or the buccal grooves of milk molars, between these points of contact. The measurements were taken on both the right and the left side of the maxillary dental arch. The mean projective distance between the point of contact of lateral incisor and canine, and the point of contact of second premolar (or second deciduous molar) and first permanent molar, in the various groups measured is shown in Table VI.

TABLE VI

DECIDUOUS DENTITION, | II/III TO | V/6

	NO. OF CASES*	MEAN, R. SIDE	NO. OF CASES*	MEAN, L. SIDE	NO. OF CASES*	MEAN, R. AND LEFT SIDES	STANDARD ERROR OF MEAN†	STANDARD DEVIATION†	STANDARD ERROR OF S. D.†
Group I, ♂	26.8	21.13 mm.	27	20.82 mm.	26.9	20.97 mm.	0.27	1.46 mm.	0.19
Group I, ♀	13	20.00 mm.	13.7	19.96 mm.	13.3	19.98 mm.	0.38	1.45 mm.	0.27
PERMANENT DENTITION, | 2/3 TO | 5/6									
Group II, ♂	17	20.23 mm.	17	20.27 mm.	17	20.25 mm.	0.36	1.49 mm.	0.26
Group II, ♀	22	19.66 mm.	22	19.25 mm.	22	19.86 mm.	0.40	1.88 mm.	0.28
Group III, ♂	14.7	19.69 mm.	14.7	19.86 mm.	14.7	19.77 mm.	0.30	1.11	0.21
Group III, ♀	37	19.32 mm.	37	19.22 mm.	37	19.27 mm.	0.40	1.51	0.18

*An occasional missing tooth prevented the taking of every measurement on each child, and reduced slightly the numbers on which the means are based.

†As the first permanent molar was missing in a number of cases, the standard errors and standard deviations were worked out on the lengths from the point 00 in the middle of the lateral incisor, to the point 11, either in the buccal groove of the second deciduous molar, or at the second premolar tip.

Such differences as are shown between measurements right and left sometimes favor one side, sometimes the other. As no type asymmetry is suggested by these means, they have been pooled to get a common mean to use in comparing one group with another by the process previously applied to the constants of Table III. The result of this comparison showed that whether one compared boys with girls, or one age group with another, no difference was found between these samples that could not quite well have been accounted for by chance in sampling from identical "populations."

Let us get the bearings of this, first considering the sexes separately. The means of our actual samples show a slight decrease with age, both for males and for females. The amount of decrease with either of the two steps forward, in either sex, is so small that, with our small samples, there is in no case any difficulty in accounting for it by random sampling, and the fact that the four moves are in the same direction may be a coincidence. If it is not, then it could only be

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accounted for by absorption of bone in the alveolar arch, or by an increase in the angle between our row of three teeth and either the median or the horizontal plane. We should want more evidence to prove that any change of this sort takes place between childhood and adulthood. At any rate it seems pretty clear

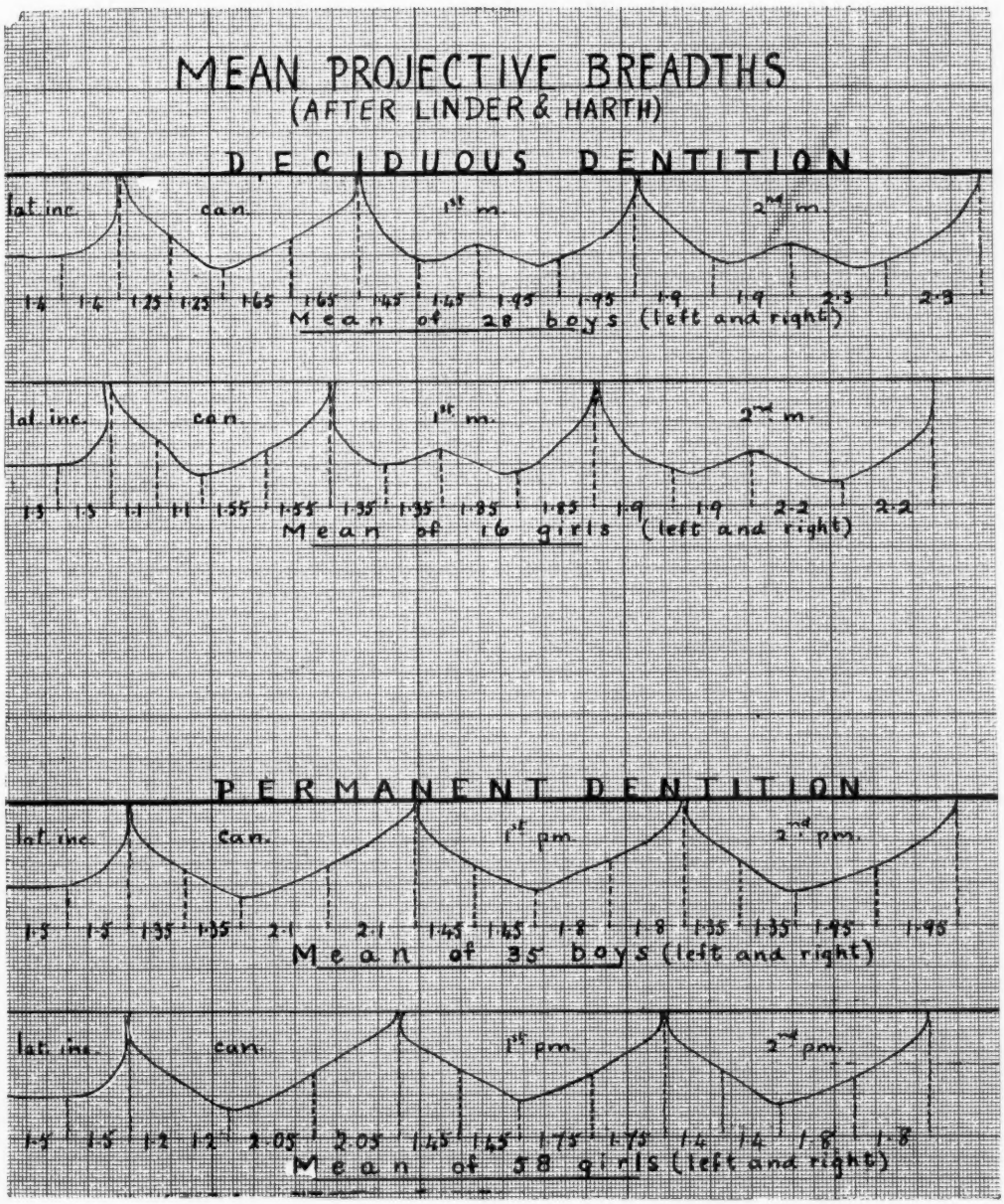
MEAN PROJECTIVE BREADTHS
(AFTER LINDER & HARTH)
DECIDUOUS DENTITION
lat. inc.
can.
1st m.
2nd m.
1·4 1·4 1·25 1·25 1·65 1·65 1·45 1·45 1·95 1·95 1·9 1·9 2·3 2·3
Mean of 28 boys (left and right)
lat. inc.
can.
1st m.
2nd m.
1·5 1·5 1·1 1·1 1·55 1·55 1·35 1·35 1·85 1·85 1·9 1·9 2·2 2·2
Mean of 16 girls (left and right)
PERMANENT DENTITION
lat. inc.
can.
1st pm.
2nd pm.
1·5 1·5 1·35 1·35 2·1 2·1 1·45 1·45 1·8 1·8 1·35 1·35 1·95 1·95
Mean of 35 boys (left and right)
lat. inc.
can.
1st pm.
2nd pm.
1·5 1·5 1·2 1·2 2·05 2·05 1·45 1·45 1·75 1·75 1·4 1·4 1·8 1·8
Mean of 38 girls (left and right)

Fig. 11.—Tooth dimensions of 137 correctly occluded children of Bonn, Germany.

that growth does not take place in this part of the arch after the time when the first permanent molar erupts. The room available for the permanent canine and the premolars is already determined long before they put in an appearance, and if they cannot fit into it in an even row, they must huddle into it as best they may. As every orthodontist knows, this best is often not very good.

Now to consider the fact that no difference is demonstrated between male and female dimensions that could not be ascribed to chance, for any of our three pairs; though it is true that in each case the difference between the samples themselves is in favor of the male. In view of the fact that no age change has been shown to occur in the space occupied by the teeth, we shall pool all our data for each of the two sexes, thus obtaining longer series and thereby reducing the allowance that must be made for mere chance. Applying the same test as before, λ_H, to our combined groups, we find that chance could account for the differ-

TABLE VII

DECIDUOUS DENTITION $\sigma + \overline{\varphi \times 1.05}$				PERMANENT DENTITION $\sigma + \overline{\varphi \times 1.035}$			
POINTS USED BY LINDER AND HARTH	MEAN DISTANCES	MIDPOINTS OF CORRESP. CATEGORIES	MEAN DISTANCES	POINTS USED BY LINDER AND HARTH	MEAN DISTANCES	MIDPOINTS OF CORRESP. CATEGORIES	MEAN DISTANCES
00 - 0	1.38 mm.	00 - 0′	1.38 mm.	00 - 0	1.51 mm.	00 - 0′	1.51 mm.
0 - 1	1.38 mm.	0′ - 1′	1.30 mm.	0 - 1	1.51 mm.	0′ - 1′	1.40 mm.
1 - 2	1.22 mm.	1′ - 2′	1.30 mm.	1 - 2	1.29 mm.	1′ - 2′	1.40 mm.
2 - 3	1.22 mm.	2′ - 3′	1.43 mm.	2 - 3	1.29 mm.	2′ - 3′	1.70 mm.
3 - 4	1.64 mm.	3′ - 4′	1.43 mm.	3 - 4	2.11 mm.	3′ - 4′	1.70 mm.
4 - 5	1.64 mm.	4′ - 5′	1.53 mm.	4 - 5	2.11 mm.	4′ - 5′	1.80 mm.
5 - 6	1.42 mm.	5′ - 6′	1.53 mm.	5 - 6	1.49 mm.	5′ - 6′	1.80 mm.
6 - 7	1.42 mm.	6′ - 7′	1.68 mm.	6 - 7	1.49 mm.	6′ - 7′	1.65 mm.
7 - 8	1.94 mm.	7′ - 8′	1.68 mm.	7 - 8	1.81 mm.	7′ - 8′	1.65 mm.
8 - 9	1.94 mm.	8′ - 9′	1.94 mm.	8 - 9	1.81 mm.	8′ - 9′	1.61 mm.
9 - 10	1.94 mm.	9′ - 10′	1.94 mm.	9 - 10	1.42 mm.	9′ - 10′	1.61 mm.
10 - 11	1.94 mm.	10′ - 11′	2.13 mm.	10 - 11	1.42 mm.	10′ - 11′	1.66 mm.
11 - 12	2.32 mm.	11′ - 12′	2.13 mm.	11 - 12	1.90 mm.	11′ - 12′	1.66 mm.
12 - 13	2.32 mm.	12′ - 13	2.32 mm.	12 - 13	1.90 mm.	12′ - 13	1.90 mm.

ence between our boys and girls only about 3 times in 100. We may take it therefore that there *is* a sex difference in size, as indeed we should expect.

In view of these findings, while keeping the sexes separate we have combined the data for the two groups with permanent dentition in averaging Linder and Harth's measurements on individual teeth, and so arrive at the mean values shown in Fig. 11.

We have seen that there is a difference between absolute dimensions for boys and girls, but is there a real difference between their tooth *proportions?* This had to be tested before we could compare the orbital plane distributions for boys and girls in the first section of this paper. The result was negative. It was therefore permissible to pool the measurements for boys and girls when once

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the latter had been increased in the proportion indicated by a comparison of their total lengths, namely an increase of 5 per cent for the girls of Group I, and one of 3½ per cent for those of the older groups. It should be noted, however, in using this scale, that the midpoints of these unequal categories do not exactly coincide with the points used in defining them. The limits of Linder and Harth's category 3 for example, would be halfway to the neighboring points 2 and 4 situated respectively in the middle of the mesial and distal edges of the canine, and as the latter are of unequal lengths, the limits of category 3 would extend rather farther distally than mesially, and its midpoint would be slightly distal to the point 3. These slight differences are of course too small to observe on the individual and of no practical importance in dealing with single cases, but in making calculations on a series a negligible error when multiplied by a large enough number may become substantial. For the convenience of others who may wish to make use of this scale, the calculated distances are given in Table VII.

I cannot close this section without again expressing my warmest thanks to Drs. Linder and Harth, and also to their chief Dr. Gustav Korkhaus, for the considerable trouble they have permitted me to cause them all by my requests for sheets of figures, for data and again data, in the course of the critical analysis which is now completed. Also my grateful thanks for permission to use their unpublished as well as their published material for this purpose. The science of orthodontia already owes much to the school at Bonn, and is certain to find its debt increased as year follows year.

CONCLUSION

Two aims were set forth as the object of our analysis. The first was to assess the knowledge gained as a result of the investigations we were to study. Now, looking back and counting our gains, we find them substantial. In the light of the researches of Linder and Harth, we have seen the maxillary alveolar arch between lateral incisor and first permanent molar, arrived at its maximum dimensions by the time the latter tooth erupts, and thereafter contributing nothing to the forward growth of the maxilla; only advancing as it is pushed from behind. We have watched, with Hellman, the forward movement of the teeth past the key-ridge—till when? At any rate till that period of dental development which ends before the eruption of the third molar. Whether there had then to be a further shift forward to make room for this last tooth was not shown, the number of adolescents being too small to demonstrate any difference that may exist between themselves and the next stage above them. When, however, we take our stand with Oppenheim at the point of *zygomaxillare*, situated at the upper limit of that same ridge, where maxilla ends and malar begins, he is able to demonstrate the more rapid forward movement of *molare* (midpoint of the occlusal surface of the first permanent molar) which enables it to catch up with *zygomaxillare* and eventually overtake it; a movement which seems not to cease until the eighteenth or nineteenth year. Finally we go with Linder and Harth to a still higher point of vantage, to Simon's *orbitale*, at the level of the orbital rim on the living head but rather in advance of it, being on a vertical

tangent to the ridge (flesh covered) which overhangs the nasal fossa. We are shown in the population of Bonn the dental arch pushing ahead of this point until the early teens. After that, if there is any gain to register, it is small enough to need more evidence to demonstrate its existence. We cannot of course assume that if the dental arch continues to gain on the lower malar border after this age is reached, it must of necessity gain on the upper too. The upper part may itself move forward after the lower has stopped, so we must leave it at present that no advance of the dental arch relative to Simon's *orbitale* has been demonstrated after the teens begin. Their mutual relationship may have been stabilized by that time. Otherwise, with regard to Simon's *orbitale,* the hypotheses put forward in 1922 have definitely been shown erroneous by Linder and Harth's investigations. Its mean position relative to the dental arch is not constant from the fifth year onward. Its position in correctly occluded children of the same age shows much larger variation than was at first supposed: in the children examined by Linder and Harth the variation exceeded 16 mm. in range and even when one rejects the tenth part of the children, the range of the more normal nine-tenths is found to be over a centimeter. Also, the mean position of the orbital plane, though near the canine tip in the five to eight year period, is between canine and premolar in the teens. The degree of constancy originally postulated is probably unattainable in any two points one of which is on and the other well above the dental arch. Absolute constancy is not needed to provide the orthodontist with a practical standard, and the way in which the orbital plane may be used for this purpose has been described in the course of our analysis.

So much for the facts that emerge concerning facial growth changes. Our second objective was the more important, since it looks, not so much to the work already done as to that much larger body of work that will be produced in the future, endeavoring to extract wisdom for the future from the mistakes of these earlier endeavors. If we take now a final glance at the notice boards that have been put up over the pits into which the pioneers stumbled, and copy out the legends as an aid to memory, we get a list somewhat to this effect:

For quantitative characters, breadth of categories must be known.

Distributions must be given in absolute numbers; percentages in addition optional.

Symmetry must not be assumed, either for the individual or for the type.

Instruments must always be tested.

A sound technic is a fundamental necessity; faulty technic can ruin the investigation.

Whatever the categories chosen, they must be treated impartially.

Constancy is a chimera in dentofacial relationships, and perfect correlation is one aspect of this chimera.

The sexes should not be mixed without previous enquiry.

All arithmetic must be checked.

Observations on a series are only of value for what they reveal concerning the population from which the series is drawn.

However perfect the observations, to attempt to interpret them apart from statistical theory is a spoiling of good cloth by crude tailoring.

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Perhaps the last notice should have been copied down in capital letters, for if this analysis should succeed to even a small extent in its object of promoting fruitful collaboration between the trained observer and the trained statistician in the interests of orthodontic progress, the pains expended upon it will have been abundantly justified.

FACIAL MEASUREMENTS IN DIAGNOSIS*

GEORGE G. CAMPION, L.D.S. (ENG.), AND DENNIS H. CAMPION, B.D.S. (MANC.),
MANCHESTER, ENGLAND

ONE of us (G. G. C.) has never regarded what is known as Angle's classification as anything better than an interim stop-gap until such time as we shall have attained some means and method of determining the sites and quantitative values of abnormalities of the face and its dental arches. The time now seems almost at hand when something more scientific in the way of a classification will be possible.

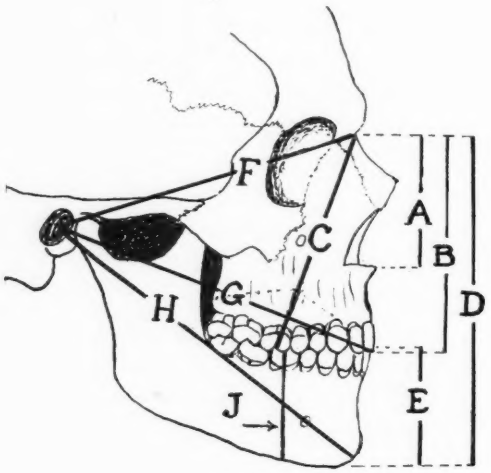


Fig. 1.

During the past six years the Dental Committee of the Medical Research Council (England) has been doing research work on the growth of the face which bids fair to provide us with data which we have hitherto lacked for guiding our judgments on abnormal cases.

Under the direction of an Anthropometric Subcommittee, Miss K. C. Smyth has made a series of measurements of the faces and dental arches of a large number of children of both sexes ranging in age from eight to fourteen years.

The children measured have been selected because they possess teeth in well-arranged and regular arches in what we usually call "normal anteroposterior occlusion."

The report of this Committee when published will provide us with a new and more scientific outlook on orthodontic cases, and the value of this cannot easily be overstated.

The face being the organ of mastication as well as of expression, it seemed not unlikely that malformations and malrelations of the dental arches should

*Paper presented at the Second International Orthodontic Congress, London, July, 1931.

be accompanied by and correlated with some discoverable malformations of facial structure, and that some mass statistics as to facial dimensions and relations in selected cases of well-formed and regular dental arches might throw light on any possible facial abnormalities in cases of irregular arches.

The facial and arch measurements adopted by the Committee were as follows: Some of them are indicated diagrammatically on a skull for purposes of clarity (Fig. 1).

FACIAL MEASUREMENTS

Vertical:

(A). Nasion to subnasal point.
(B). Nasion to incisive margin of $\frac{1 \mid 1}{}$.
(C). Nasion to palatine cusp of $\frac{6 \mid 6}{}$.
(D). Nasion to submental point.
(E). Incisive margin of $\frac{1 \mid 1}{}$ to submental point.
(J). Tip of anterior buccal cusy of $\frac{6 \mid 6}{}$ to lower border of mandible.
Tip of palatine cusps of $\frac{6 \mid 6}{}$ to the vault of the palate.

Breadth:

Bizygomatic.
Bigonial.

Anteroposterior:

(F). Transmeatal axis (external auditory meatus) to nasion.
(G). Transmeatal axis to (1) midalveolar point, maxilla,
(2) incisive margin of $\frac{1 \mid 1}{}$,
(3) midalveolar point, mandible.
(H). Transmeatal axis to mental point.

DENTAL ARCH MEASUREMENTS

Length:

From buccal aspects of incisive margins of the central incisors to the most distal points on the distal surfaces of the first molars (maxillary and mandibular arches). These measurements are taken with a specially designed instrument.

Breadth:

Between the points most distant from one another on

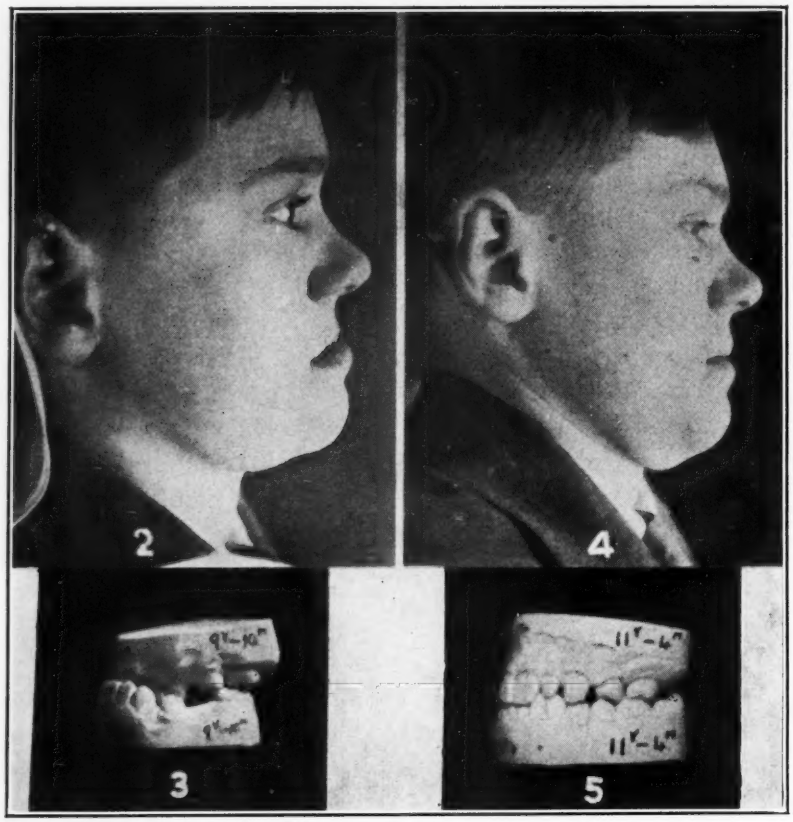
(a) the buccal surfaces of $\frac{d \mid d}{d \mid d}$ or $\frac{4 \mid 4}{4 \mid 4}$ according to the stage of development of the arches.
(b) similar points on the buccal surfaces of $\frac{6 \mid 6}{6 \mid 6}$

Size of Individual Teeth:

The width of the maxillary incisors is also being measured to enable a correlation to be established between incisor width and the width of the arch as a whole.

The problem soon to be facing us is the application of the various means and correlations which will be contained in the report to the examination of individual cases of abnormality.

A very real difficulty arises from the fact that we have to compare the measurements of each of several dimensions of *one* face with the means of a large number of measurements of the corresponding dimensions of a *group* of patients of the same age, height or weight. The individual face of the case under study may be broad or narrow, long or short; and its different dimensions may vary in accordance with these individualities and with the different racial characteristics which it may exhibit. To obviate some of the more manifest of the errors which will confront us in such complexities, our comparison cannot be a simple one of the measurements of the various facial dimensions



Figs. 2-5.

of the one child with the means of the measurements of a large group of children of the same sex, age, height or weight. Our comparison must be a statistical comparison such as is partially illustrated by the following case.

Fig. 2 shows a face of which Chart 1 gives the facial dimensions set out in accordance with a scheme of statistical comparison for which I am indebted to Dr. Matthew Young, the statistician to the Medical Research Council. This case is one which a casual glance might assign at once to Class III (Angle). It has also been regarded as a case of Hapsburg jaw. An examination of the measurement chart shows, however, that the mandible is not larger but somewhat smaller than the mean of the corresponding age group of selected cases (T. A. to M. P.) and that the abnormality of the face as a whole lies not in the

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CHART 1

MEASUREMENT CHART OF FACE SHOWN IN FIG. 2.
November 1, 1929. N. N. (boy), aged 9 years, 10 months
Standard (9-10 years—Boys)

FACE	A	B	C		D	
			+	−	+	−
Height						
N to S. N. P.	40	42.4 3.77		2.4		0.6
N to Up. Inc.	66	67.3 3.90		1.3		0.3
N to 6|6	70	69.7 3.31	0.3		0.1	
N to S. M. P.	97	100.8 5.36		3.8		0.7
L. I. to S. M. P.	40	36.9 2.25	3.1		1.4	
L. M. to L. B. M.	29.5	30.3 2.02		0.8		0.3
H. of Palate	15	16.41 1.37		1.4		1.0
Breadth						
Zyg. Breadth	119.5	121.4 3.83		1.9		0.5
Big. Breadth	97	97.9 4.11		0.9		0.2
Ant.-Post.						
T. A. to N.	85.5	88.0 3.62		2.5		0.7
T. A. to U. I. G. M.						
T. A. to U. I. I. M.	83	90.5 4.34		7.5		1.7
T. A. to L. I. G. M.						
T. A. to M. P.	99	101.2 4.42		2.2		0.5
Proj. Up. Inc. Lower	−0.5					
ARCHES						
Length						
Length Up.	34.5	39.6 2.21		5.1		2.3
Length Lo.	35.0	35.20 1.87		0.2		0.1
Breadth						
Up. D or 4	47.5	44.1 2.13	3.4		1.6	
Up. 6	54.7	56.0 2.09		1.3		0.7
Lo. D or 4						
Lo. 6	50.7	53.8 2.00		3.1		1.5
Width Up. Cent.						
With Up. Cent. × 5.3 = approx: width upper arch at 4|4	8.5	Appropriate arch width 4|4 = 45.1				

Col. A. = Measurements of particular case.
Col. B. = Means and standard deviation of corresponding height or age group.
Col. C. = + or − comparison of A with B.
Col. D. = C divided by standard deviation of appropriate group mean.
This gives the individual peculiarity for each of the 21 measurements.

mandible but in a defective anteroposterior growth in the region of the maxilla extending upward to the nasion: that this defective growth is most marked in the facial dimension—transmeatal axis to the maxillary incisors—and especially in the length of the maxillary dental arch.

The models (Fig. 3) show that the first molars are in normal anteroposterior occlusion, and Fig. 4 shows the improvement in the facial lines which resulted from bringing the maxillary and mandibular incisors into the relative positions shown in Fig. 5. Here a measurement of the face and arches and a comparison of their several dimensions with the mean figures of the corresponding age group of selected cases serve to disclose the precise locality of the defective growth and so determine the diagnosis.

In the measurement chart:

Column A shows the measurements of the individual case being examined.

Column B shows the means and standard deviations of a group of children of the same sex, age, height or weight.

Column C shows deviations, plus or minus, of the individual from the means in Column B.

Column D shows the variations seen in Column C divided by the standard deviations of the means of the corresponding facial or arch dimensions.

In Column D is shown the result of a statistical method of comparing the different facial dimensions of one individual with the corresponding dimensions of the appropriate sex, age, height or weight group.

In this method of statistical comparison a dimension of which the figure in Column D exceeds 2 would usually be held by statisticians to be abnormal. But in so complex a structure as the face no mere comparison of its various dimensions with the means of a group can suffice for our purpose: for in the human face the subtleties of that mysterious metaphysical quality which we call beauty depend far more on the correlations of the various dimensions with one another than on a comparison of the measurements of the several dimensions with any means.

The report of the committee will, when published, show a large number of correlations which have been worked out between different pairs of facial dimensions, and it will be our business to learn how to apply these to the diagnosis of faciodental abnormalities. These are matters which can only be studied when the report has been published in full. Our problem will then be twofold: first, to use it for a statistical comparison of the various facial dimensions of the abnormal case with those of the appropriate group of selected cases; and, second, to use it also for comparing the various correlations of the means with those of the abnormal face.

There can be no better illustration of the prospective value of the data which will be contained in the report than that which is furnished by the paper recently published by Milo Hellman on "Open-Bite." For lack of adequate statistical data derived from living faces possessing well-formed arches in normal occlusions Hellman was compelled to obtain his data for comparison largely from skulls. But a comparison of the facial dimensions of living open-bite cases with the means of a large number of similar measurements of cases selected for normal arches in normal occlusion may be expected to yield us far more valuable results, and the data for such a comparison in adequate quantity

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and treated by adequate statistical method will be furnished in the report to which we have referred.

Hellman's study of skeletal material led him to the inference that "the occlusal disturbance known as open-bite is in constant relationship with an absolutely or relatively short ramus and body of the mandible and not with an arrest of development of the incisor region."*

The observations of one of us (G. G. C.) during the past ten years make us think that this view will be modified as the result of the examination of individual cases of this deformity by means of the data with which the Committee's report will furnish us. When an adequate study of such cases will have been completed, we shall find that a short ramus and short body of the mandible are only two of the possibly abnormal conditions. In addition to these there will be found also in some of the varieties of the deformity: (1) lack

Fig. 6.

Fig. 7.

of growth downward of the maxilliary incisors; (2) abnormal growth downward of the maxilliary molars; (3) an abnormally oblique angle of the mandible. A fine discrimination between these different conditions of abnormal growth can result only from careful anthropometric study.

Figs. 6 and 7 show the face and models of such a case, and Chart 2 gives its measurements. This shows that in addition to the lack of development of the mandible there is an abnormal downward growth of the maxiliary molars. This condition has also been shown by Simon in such cases and is entirely congruous with the conclusions at which Brash arrived in his studies of bone growth.

The Dental Investigation Committee of the Medical Research Council has earned the gratitude of the dental profession by this long and valuable piece of research. When its report on this work is published, we shall be in a better position than we are today to study and classify orthodontic cases more in accordance

*Hellman, Milo: Open-Bite, INTERNAT. J. ORTHOD., ORAL SURG. & RADIOG. **17**: 443, 1931.

CHART 2

MEASUREMENT CHART OF FACE SHOWN IN FIG. 6

J. C. (girl)

Standard (9-10 years—Girls)

FACE	A	B	C		D	
			+	−	+	−
Height						
N to S. N. P	43	41.2 3.03	1.8		0.6	
N to Up. Inc.	67	64.3 3.96	2.7		0.7	
N to 6|6	77.5	67.5 3.10	10.0		3.2	
N to S. M. P.	112.5	97.1 4.61	15.4		3.3	
L. I. to S. M. P.	42.5	35.3 2.04	7.2		3.5	
L. M. to L. B. M.	32.5	29.3 1.83	3.2		1.7	
H. of Palate	19	16.0 1.45	3.0		2.1	
Breadth						
Zyg. Breadth	119	119.1 4.03		0.1		0.0
Big. Breadth	93	94.89 3.72		1.9		0.5
Ant.-Post.						
T. A. to N.	89	84.6 4.14	4.4		1.1	
T. A. to U. I. G. M.	88	84.9 4.49	3.1		0.7	
T. A. to U. I. I. M.	92	87.3 4.61	4.7		1.0	
T. A. to L. I. G. M.	83	85.6 4.19		2.6		0.6
T. A. to M. P.	94.5	98.0 4.75		3.5		0.7
Proj. Up. Inc.	14					
ARCHES						
Length						
Length Up.	43.0	38.8 2.07	4.2		2.0	
Length Lo.	32.5	34.3 1.58		1.8		1.1
Breadth						
Up. D or 4	36.5	42.7 1.71		6.2		3.5
Up. 6	50.5	53.7 1.99		3.2		1.6
Lo. D or 4	40.5	37.4 1.72	3.1		1.8	
Lo. 6	52.5	52.0 1.83	0.5		0.3	
Width Up. Cent.	9.1	Appropriate arch width 4|4 = 48.2				
Width Up. Cent. × 5.3 = approx: width upper arch at 4|4						

Col. A. = Measurements of particular case.
Col. B. = Means and standard deviation of corresponding height or age group.
Col. C. = + or − comparison of A with B.
Col. D. = C divided by standard deviation of appropriate group mean.
This gives the individual peculiarity for each of the 21 measurements.

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with the anatomic abnormalities which they exhibit as a preliminary to the closer consideration of their etiology. It will open up a new field for research work by making possible a finer differentiation in diagnosis. This paper presents only a preliminary glance at a synoptic view of the whole subject, which has been the steady growth of a quarter of a century. With the publication of the report referred to, a dream which one of us had more than twenty-five years ago will have become an actuality. We shall have a scientific standard with which to search in detail for the sites of abnormal growth in different parts of the face and in different orthodontic types. Some years of study will be needed to learn precisely the right way to use this new instrument of investigation and to reap fully the advantages which it will place in our hands, but surveying the work of the past quarter century and realizing the advantage we personally have derived from a partial and limited application of

Fig. 8.

these anthropometric methods, we venture to hazard the guess that when another quarter century shall have elapsed after the publication of this report, what is now called Angle's classification will have become relegated to what will then be regarded as a prescientific period in orthodontics.

In the demonstration on a subsequent day the following two cases were presented to us for measurement, neither of which had been seen by us before the meeting.

Fig. 8 shows the models of a case of open-bite, and Chart 3 of the measurements is appended.

It will be seen that as an accompaniment of the open-bite the entire length of the measured face N to S.M.P. exceeds by 14.3 mm. the mean of the group of normal cases of the same age and sex; that every several height dimension of the face is in excess of the corresponding mean; and that the measurement N to $\underline{6 \mid 6}$ is in excess to the extent of 10.6 mm. According to the experience of one of us (G. G. C.) during the past six years this increased measurement from N to $\underline{6 \mid 6}$ is a common feature of many of these cases, and this is usually correlated with an increased height of palate. In this case the increased height

CHART 3

MEASUREMENT CHART FOR FIG. 8

July 22, 1931. S. E. (girl), aged 11 years, 5 months

Standard (11-12 years—Girls)

FACE	A	B	C		D	
			+	−	+	−
Height						
N to S. N. P.	51.5	42.8 2.89	8.7		3.0	
N to Up. Inc.	73.5	67.2 3.68	6.3		1.7	
N to 6|6	80.5	69.9 3.36	10.6		3.16	
N to S. M. P.	115.5	101.2 5.00	14.3		2.8	
L. I. to S. M. P.	40	37.0 2.28	3.0		1.3	
L. M. to L. B. M.	32	31.6 2.06	0.4		0.2	
H. of Palate	19	17.2 1.49	1.8		1.2	
Breadth						
Zyg. Breadth	132	121.7 5.16	10.3		2.0	
Big. Breadth	105	96.6 4.46	8.4		1.9	
Ant.-Post.						
T. A. to N.	94	87.7 3.86	2.3		0.6	
T. A. to U. I. G. M.	88	88.1 4.92		0.1		0.0
T. A. to U. I. I. M.	93	89.8 4.80	3.2		0.7	
T. A. to L. I. G. M.	88	68.5 4.64		0.5		0.0
T. A. to M. P.	102	101.5 5.14	0.5		0.1	
Proj. Up. Inc.	+8					
ARCHES						
Length						
Length Up.	38	37.7 2.13	0.3		0.1	
Length Lo.	31	32.7 2.09		1.7		0.4
Breadth						
Up. D or 4	41	44.0 2.17		3.0		1.4
Up. 6	51	55.0 2.14		4.0		1.9
Lo. D or 4		38.9 1.84				
Lo. 6	54	52.9 1.71	1.1		0.6	
Width Up. Cent.						
Width Up. Cent. × 5.3 = approx: width upper arch at 4|4	7.5	Appropriate arch width 4|4 = 39.8				

Col. A. = Measurements of particular case.
Col. B. = Means and standard deviation of corresponding height or age group.
Col. C. = + or − comparison of A with B.
Col. D. = C divided by standard deviation of appropriate group mean.
This gives the individual peculiarity for each of the 21 measurements.

CHART 4

MEASUREMENT CHART FOR FIG. 9

July 22, 1931. C. M. (boy), aged 9 years, 4 months

Standard (9-10 years—Boys)

FACE	A	B	C		D	
			+	−	+	−
Height						
N to S. N. P.	49.5	42.4 3.77	7.1		1.9	
N to Up. Inc.	73	67.3 3.90	5.7		1.5	
N to 6|6	77	69.7 3.31	7.3		2.2	
N to S. M. P.	103	100.8 5.36	2.2		0.4	
L. I. to S. M. P.	37.5	36.9 2.25	0.6		0.27	
L. M. to L. B. M.	29.5	30.3 2.02		0.8		0.4
H. of Palate	16.5	16.4 1.37	0.1		0.0	
Breadth						
Zyg. Breadth	116	121.4 3.83		5.4		1.4
Big Breadth	93	97.9 4.1		4.9		1.2
Ant.-Post.						
T. A. to N.	84	88.0 3.62		4.0		1.1
T. A. to U. I. G. M.	84	88.28 4.05		4.3		1.0
T. A. to U. I. I. M.	89	90.47 4.34		1.5		0.1
T. A. to L. I. G. M.	79	88.7 4.27		9.7		2.3
T. A. to M. P.	93	101.2 4.42		8.2		1.9
Proj. Up. Inc.	+9.5					
ARCHES						
Length						
Length Up.	45	39.6 2.21	5.4		2.4	
Length Lo.	33	35.2 1.87		2.2		1.2
Breadth						
Up.						
Up. 6	51.5	56 2.09		4.5		2.1
Lo.						
Lo. 6	50	53.9 2.0		3.9		1.9
Width Up. Cent.						
Width Up. Cent. × 5.3 = { approx. width upper arch at 4|4	9.3	Appropriate arch width 4|4 = 49.3				

Col. A. = Measurements of particular case.
Col. B. = Means and standard deviation of corresponding height or age group.
Col. C. = + or − comparison of A with B.
Col. D. = C divided by standard deviation of appropriate group mean.
This gives the individual peculiarity for each of the 21 measurements.

of the palate was 1.8 mm. This increased growth in the dimension N to $\frac{6}{6}$ and also in the height of the palate is entirely congruous with cases which Simon has published after examination by his method with measurements from the Frankfort plane.

Fig. 9 shows models of a case of distoclusion of the mandibular arch, and Chart 4 of measurements is appended. In this case, which would in previous times have been called a case of maxilliary protrusion, the facial features were marked by the maxillary incisors closing outside the lower lip. Today this case would be called in Angle terminology Class II, Division 1. It will be noticed from the chart of measurements that all the anteroposterior dimensions of the face are minus in comparison with the means of the age and sex group. The figures show also that this defective anteroposterior measurement is correlated with diminution in the breadth of the face, while on the other hand the height of the face is in all the measured dimensions except one, in excess of the means of the corresponding normal age group.

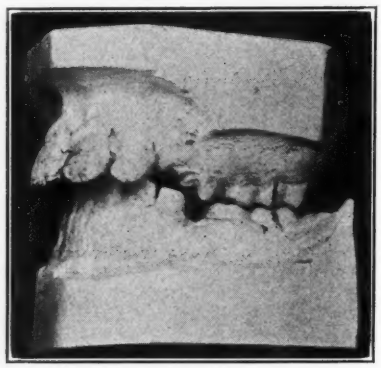

Fig. 9.

These cases are typical of many which we have examined in this way and which have forced us to the conclusion that the long piece of research work conducted by Miss Smyth under the direction of the Dental Committee of the Medical Research Council opens up a wide field for the investigation in the future of abnormal faces in relation to abnormal dental arches.

DISCUSSION

Mr. T. M. Hughes, Manchester, England, said with reference to the measurements of the face and dental arches as formulated in Mr. Campion's paper, there was one small omission to which he would like to refer, and which he thought was of interest.

First, he wished to mention that for some years it had been his privilege to study these measurements under the able and generous guidance of Mr. Campion at the Manchester school.

A short time ago it occurred to him that if this biometric system of diagnosis was to be a challenge to the scientific accuracy of Angle's classification, it should necessarily include a certain specific measurement, viz., the anteroposterior position of the maxillary first molar, in that area of the skull which lies in front of the external auditory meatus. For ordinary anatomic purposes this area is known as the face, as distinct from the cranium; but as the external auditory meatus is situated in the temporal bone (which is a cranial and not a facial bone) a better name is that which was first used, he believed, by Mr. Campion, viz., "the

masticating face.'' This name is specially suitable and appropriate when one considers that the two most powerful elevators of the mandible—the temporal and masseter muscles—both have a portion of their origins in the temporal bone.

Now, he was fairly well convinced that it is extremely difficult to define by these measurements the exact position of each molar on its own side. But for the purpose in question, it is quite enough to define the plane of the mesial surfaces of these two teeth—right and left. (This plane is a transverse vertical one, parallel to the coronal plane.) To do this is comparatively easy; in fact it can be ascertained by two methods, viz., direct and indirect. The direct method is to use a transverse bar attached to the measuring rod of the prosopometer, very similar in principle to that used for defining the occlusal plane of these two teeth in the vertical measurements.

The indirect method is equally simple; the anteroposterior length of the maxillary arch is taken from the central incisors to the mesial surfaces of the first molars, and this is subtracted from the measurement of the transmeatal axis to the maxillary central incisors. There is no doubt whatever that this measurement will prove that the anteroposterior position of these two teeth in the masticating face is a varying one.

Now, in spite of the fact that he was a biased disciple of biometrics, he hastened to assure his American friends and colleagues that he did not think for one moment that the classification of their distinguished countryman was going to be scrapped by these measurements. No, he was confident that the Angle classification would continue to fulfill its useful work in private practice, in hospitals, and in international orthodontic literature, but in a limited degree. It would be used to make an initial provisional diagnosis limited to the dental arches. But when it came to the question of treatment of difficult and abstruse cases, the necessity of these measurements was indisputable; because, given two apparently similar cases of gross abnormality, both belonging to the same division of the same class of Angle, it was not only possible but very probable that the biometric test would demand a different treatment for each case.

In conclusion, if it was desired to include this measurement in a series already completed, he thought, with one proviso, it could easily be accomplished by the indirect method. The proviso was the necessity of ascertaining the mean mesiodistal diameter of the maxillary first molar, which is approximately 11.5 mm.

Dr. Korkhaus, Bonn, Germany, said he wished to thank Dr. Campion for his very interesting paper. He believed that this work which Dr. Campion and his coworkers had done was also a very important thing for the general orthodontic practice. Anthropologic measurements of the face give use an idea of the normal development and of the consequences of the forces of the influence of our apparatus. It must always be remembered that the difference in the face of the child who comes to be treated, and the face after treatment cannot alone be caused by the apparatus or treatment, but that it is also part of the normal and natural development. He hoped that these researches by Dr. Campion would be still further widened in the future by other results which would give us an idea of the normal dimensions, the biometric dimensions of the faces and the different dimensions of the various types of constitution. He believed that a general biometric normal number of dimensions would not be enough in Europe because of the very mixed people and that it would be necessary to differentiate between the various types.

Mr. Campion said his reply must be simply a question of thanking Dr. Korkhaus and Mr. Hughes for the remarks they had made. The discussion of the various points which have been raised in this paper and all other papers would go on for some years, and not only at a meeting like this. We must now await the publication of the report which has been referred to, of the Dental Committee of the Medical Research Council.

A REPORT OF CASES TREATED BY USE OF LINGUAL, LABIAL APPLIANCES AND GUIDE PLANE*

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IN the treatment of any orthodontic case the first important consideration is the diagnosis of that particular case. The diagnosis is a most important element in the success of every case; otherwise much of the effort devoted to treatment is a waste of time for both patient and operator. When a patient presents himself for treatment, every consideration possible should be given to that particular case. While all cases may fall into a certain classification, yet a more detailed examination will show many variations from the general classifications. In order to make a complete examination you will find a good set of record models, a complete x-ray examination of the mouth, and photographs of the patient most indispensable. Included with the diagnosis, a complete history of the patient should be taken and all data, such as childhood diseases, environmental conditions and hereditary influences, carefully tabulated.

THE ORTHODONTIC APPLIANCE

After the complete diagnosis of the case has been made, the next important step is the selection and design of the appliance. This is very important for the success of any case.

It has been shown (more so in the most recent years) that the appliance should not be so rigid as to keep the teeth immovable or to interfere with the natural processes which are at work at all times. While tooth movement is absolutely necessary in the correction of any orthodontic case, that movement should be on the order more of a stimulation causing bone changes rather than of a mechanical process of tooth movement.

ANCHORAGE

A very important principle to consider in every case is that of stability of anchorage. It is absolutely necessary to have the proper anchorage before tooth movement can be accomplished to the desired effect. It is the foundation of all orthodontic appliances and a most important influence for the success of the case. Without the proper anchorage it is impossible to control the movement of the teeth in the proper direction.

SELECTION OF APPLIANCES

In the selection of any type of an appliance many considerations should be borne in mind by the operator. Some of the most important principles are:

1. *Efficiency.* An appliance should be so constructed that it will do the required work for that particular case.

*A demonstration clinic presented by Claude R. Wood at the Second International Orthodontic Congress, London, July, 1931.

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2. *Simplicity.* The appliance should be constructed in as simple a manner as possible, leaving out all the unnecessary attachments.

3. *Rapidity of Action.* The appliance should be so constructed that it will do the required work in as short a time as possible, yet keep within the bounds of physiologic tooth movement.

4. *Least Interference With Speech and Mastication.* It is absolutely necessary that the patient should have the least possible interference with mastication during orthodontic treatment, also with his speech.

5. *Cleanliness.* The appliance should be so constructed that it is easy for the patient to keep it as clean as possible at all times.

6. *Inconspicuousness.* While not an absolute requisite in all cases, inconspicuousness is most desirable and in some cases almost necessary for the success of the patient.

7. *Stability.* The appliance at all times should be stable enough to do the desired work without the misplacement of any teeth.

With these ideas in mind we have selected a type of appliance which we think the most desirable in the treatment of the following cases which we shall describe:

Case 1.—The patient, eight years of age, presented for treatment. After examination of the case the diagnosis was that of Class I with narrow arches and crowded condition of the anterior teeth in the maxillary and mandibular arches, with the left maxillary lateral incisor in lingual occlusion with the mandibular. (Fig. 1.)

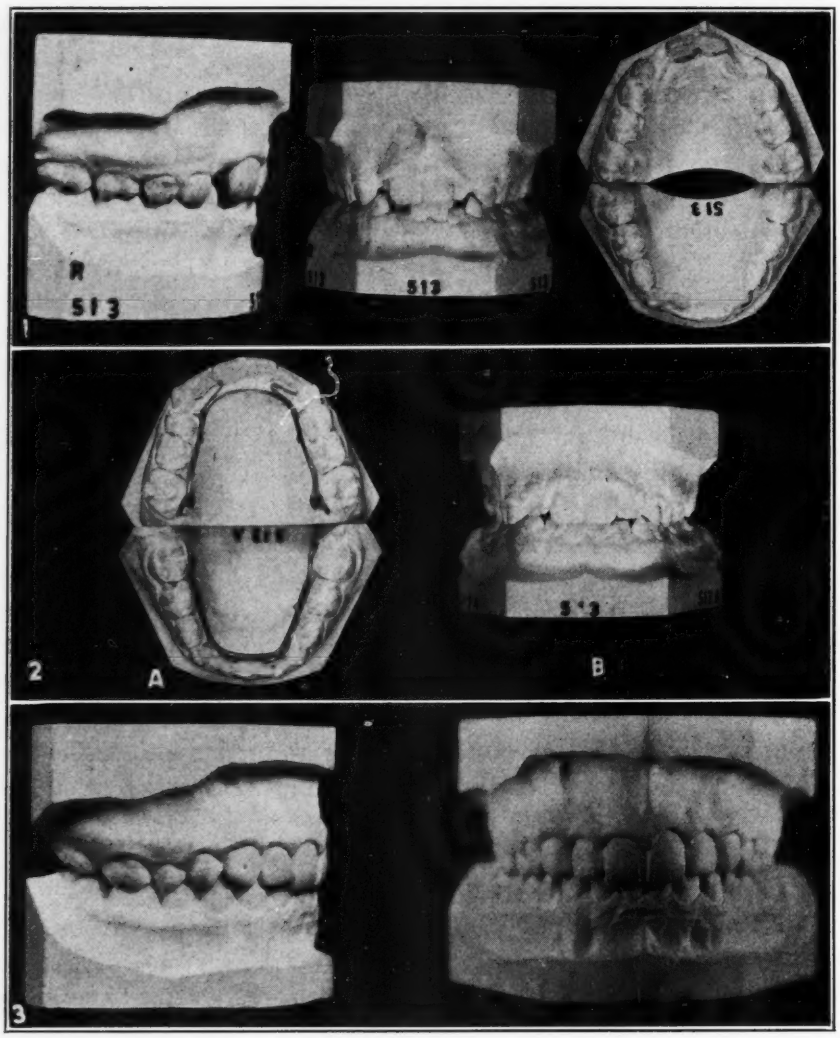
Direct bands were made on the first molars. There is no need of going into minute detail of the construction of these bands, but it is absolutely essential that good fitting bands should be had in all cases. They should be so constructed as not to interfere with the occlusion of the teeth or with the mastication and yet not to impinge upon the soft tissues. Half-round tubes were soldered to the maxillary bands. The tubes are placed in the center with a five degree inclination posterior to take care of the posterior inclination of the maxillary molars. The tube is soldered as close to the gingival edge as possible, but so as not to impinge upon the soft tissues.

After the bands are well fitted, an accurate impression is made in modeling compound. The bands are then placed in the impression and sealed with sticky wax. A stone model is poured. After thorough hardening this is separated. Trim this working model in such a way that it will be convenient to work with. Care must be taken to see that all the teeth are clearly outlined on this working model. If necessary a prothro spatula is used to outline clearly the gingival margin of each tooth.

A lingual body wire of 0.040 Deepep wire is used to construct the lingual arch, the half-round wire being soldered to the arch wire and of such a size to fit the half-round wire. In the maxillary arch an auxiliary spring was soldered from the premolar region extending to the anterior with a recurve at the end of the wire so as to engage the maxillary lateral incisors that were in lingual occlusion. In the mandibular arch simple recurve springs were used extending to the centrals so as to create a lateral development. The patient was seen at intervals of about three weeks, at which time adjustments were made.

At the end of eighteen months the lateral incisors were in correct position as shown in Fig. 2 *A* and *B*.

The appliances as shown in Fig. 2 *A* were the original appliances used in the case. You will notice the efficient way in which the small recurve spring on the maxillary lingual appliance produced movement in the lateral region correcting the lingual occlusion of the lateral incisors. At this time new appliances were constructed so as to engage the lingual surfaces of all the teeth.



Figs. 1, 2, and 3.

More development was created in the lateral direction for a short period. Later all of the appliances were taken off, and the case continued to develop in a normal way, resulting in a beautifully formed arch and good occlusion as shown in Fig. 3.

ROTATION OF TEETH

Case 2.—The patient, nine years of age, presented for orthodontic treatment with maxillary lateral incisors completely rotated as shown in Fig. 4 *A*.

Bands were made on the first permanent molars. A lingual arch for stabilization was used.

A medium high labial arch was used. Bands were placed on the lateral incisors. Round tubes, 0.022, were soldered on the lateral bands on the distal third portion parallel with the long axis of the tooth. Deepep wire, 0.022, was soldered to the main arch wire, and a U-shaped portion was formed with the distal end placed in the round 0.022 tube as shown in Fig. 4 *B*.

The straight portion of the 0.022 wire formed a leverage by which pressure was exerted on the mesial angle of the incisors, and by making a bend in the labial direction of the end portion of the wire and placing it in the round 0.022 tube, pressure was exerted so as to cause the distal portions to be rotated in proper position as shown in Fig. 4 *C*.

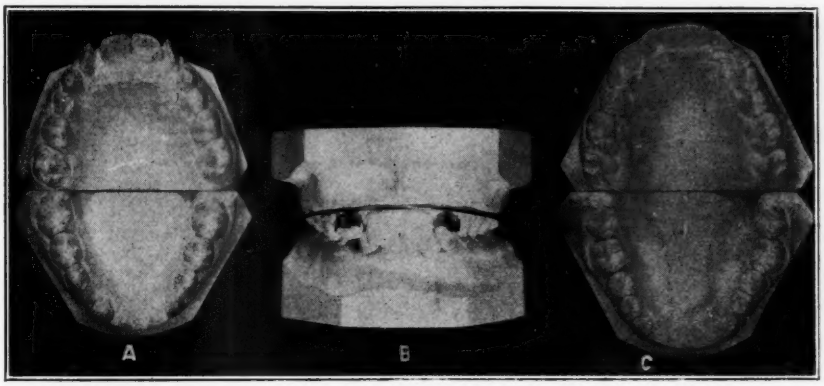


Fig. 4.

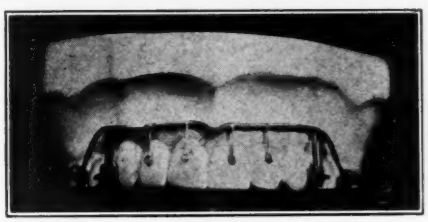


Fig. 5.

By means of the bands and round buccal tubes a direct, more even, and gentler pressure is exerted than that used by ligations of ligatures.

THE HIGH LABIAL ARCH

Case 3.—Fig. 5 shows the high labial arch as used in the treatment of some orthodontic cases. This may be used alone or in conjunction with the lingual appliance. Bands are placed on the molars in the usual manner. As an additional part of the anchorage, bands may be placed on the first premolars. If you do not care to use a whole lingual arch, a portion may be soldered to the lingual surface of the premolar bands engaging the canine and second premolar. To stabilize the main arch wire 0.022 round buccal tubes may be soldered on the buccal surface of the premolar bands, perpendicular to the long axis of the tooth. The high labial arch is formed by carrying the main arch wire as in the

medium or low labial, except that in the premolar region it is carried high and from the canine region it is carried straight across to the other canine or premolar region where it is gradually sloped and enters the buccal tube on the other side in a parallel position. It is often necessary in these cases to form a U-shaped portion in the central region to take care of the frenum. An 0.022 wire is soldered to the main arch wire and carried down to the 0.022 buccal tube where a right angle bend is made and placed in the 0.022 tube. By this means the arch wire is under absolute control at all times. Extensions are soldered from the main arch wire down to engage the four incisors. You will find that by forming a loop at the ends of these wires it will be a very convenient adjunct in case ligation is necessary in the movement of the anterior teeth. In case intermaxillary force is needed, the intermaxillary hooks are soldered in the same manner as is the medium labial arch. (We are indebted to Dr. J. W. Ford of Chicago for presenting this case.)

THE GUIDE PLANE

CASE 4.—A patient, thirty-one years of age, presented for treatment with a badly mutilated distoclusion. The case was complicated by an extreme overbite, with bunched mandibular incisors and a retrusion of the maxillary centrals and right lateral and a protrusion of the left maxillary lateral incisor with a complete labial version of the right maxillary second premolar, as illustrated in Fig. 6.

Bands were placed on the mandibular first molars. A mandibular lingual arch was constructed; recurve finger springs were soldered engaging the premolar, canine, laterals, and centrals on both sides. This was used to create expansion in the mandibular arch. A labial alignment wire was used to help stabilize the mandibular arch.

Bands were placed on the maxillary first molars with half-round tubes. Because of the deep overbite in this case and the distoclusion which was present a guide plane was used to open the bite. It was so constructed as to place the mandibular arch in normal relation with the maxillary. In the construction of this guide plane a regular lingual arch was first constructed. Then an auxiliary wire 0.030 in diameter was soldered to the arch wire in the canine region. The height of this guide plane is determined by the amount of open-bite that is desired in any particular case. The location is determined by occluding the two arches, and it is so placed as to cause the mandibular arch to bite anteriorly and in proper position. After the height is determined, it is soldered to the opposite side at about the same position. Occlude the models together and see that everything is at the desired position, then by heat treating with the models occluded together, it is made passive. The arch is then removed from the model and is interlaced with 0.022 wire. It is then placed back on the model and made passive. It is impossible because of limited space to describe in detail the construction of this guide plane, as it should be accompanied by many illustrations, but it may be found in print in articles written by one of us (O. A. O.).

In this particular case it was found that the central incisors and the right lateral incisors retruded. In order to bring these forward, extensions were sol-

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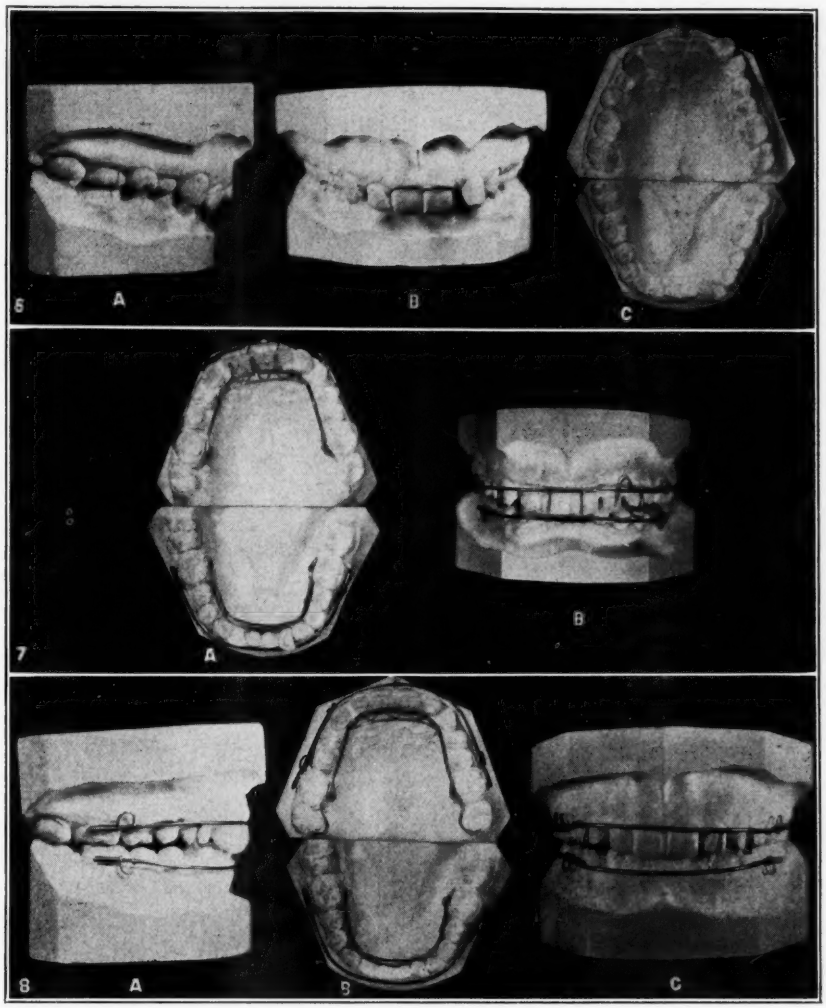
dered from the main arch wire touching the lingual surface of these teeth. These were gradually opened from time to time carrying the teeth forward as shown in Fig. 7 *A*.

A labial appliance was used, and intermaxillary hooks were attached to the labial appliance for the use of intermaxillary elastics. An extension was soldered in order to depress the left lateral incisors, which were protruding. Extensions



Figs. 6, 7, and 8.

were soldered and looped over the incisal edges of the central incisors in order to depress these two teeth, as shown in Fig. 7 *B*.

After the patient had worn these appliances for about six months, it was found that the teeth had moved far enough that a new set of appliances was needed. A new lingual appliance was constructed in contact with the lingual surfaces of the central incisors, which had been moved forward. Employing the same method as before, the new guide plane was built so as to open the bite sufficiently to allow the teeth to elongate to their normal position, as shown in Fig. 8 *A*.

It was found during the treatment that because of the great amount of pressure exerted on the molars there was a slight depression of the first molars. In order to overcome this and further to stabilize the guide plane, extensions were used from the lingual appliance engaging the second molars, as shown in Fig. 8 *B*.

These extensions are a most useful adjunct in the treatment of all types of malocclusion. They aid in the stabilization of the appliance and prevent displacement of the banded tooth. If used in the mandibular appliance, as indicated by pencil mark in Fig. 8 *B*, they are made to rest in the lingual pit of the tooth posteriorly to the banded tooth, while on the maxillary appliance because of the occlusion it is necessary to make extensions rest in the distal pit.

Fig. 8 *C* shows the labial view of the new appliance, it also shows the progress of the case up to the present time. You will notice in comparison with Fig. 6 *A* that the bite has been opened considerably. It was found necessary to use extensions for the left maxillary and mandibular incisors in order to depress them to their proper places.

We are very sorry not to have a further model of this case, but in order to show the great amount of good that can be accomplished in older cases, as of this patient thirty-one years of age, we thought it would be interesting to show the remarkable results obtained.

THE TREATMENT OF DISTOCLUSION BY THE USE OF THE GUIDE PLANE

CASE 5.—The patient, ten years of age, presented for treatment with a complete distoclusion with protruding anterior teeth in the maxillary arch and narrow maxillary and mandibular arches with a complete lingual occlusion of the left mandibular first premolar, as shown in Fig. 9.

Lingual appliances were constructed for the mandibular arch, recurve finger springs were soldered for lateral development. Intermaxillary hooks were soldered on the mandibular bands for use of intermaxillary elastics.

A guide plane was constructed in the maxillary arch, as shown in Fig. 10 *A*. It was so constructed that when the patient closed the teeth the mandibular arch was brought into normal position, as shown in Fig. 10 *B*. It was placed so that the patient could not bite back of this guide plane but anteriorly to it.

Extensions were soldered on the labial appliance in order to depress the four incisors. Intermaxillary hooks were placed in the usual place for the use of the intermaxillary elastics, as shown in Fig. 10 *C*.

The patient continued to wear this appliance for about six months, when it was found necessary to construct another appliance. A new lingual arch was constructed in the maxillary arch, lying close to the lingual surfaces of all the teeth. Recurve auxiliary springs were soldered for further development of the arch. It was found that the left second molar was in lingual occlusion. An extension was soldered to the posterior end of the appliance in order to move the second molar into normal position, as shown in Fig. 11 *A*. It also shows the new guide plane that was constructed for the maxillary arch. This was constructed in the same manner as the first, only it was made a little steeper in order to open the bite to allow the premolars to erupt to their normal position. Fig. 11 *B* shows the labial appliance with the intermaxillary hooks. It also shows the

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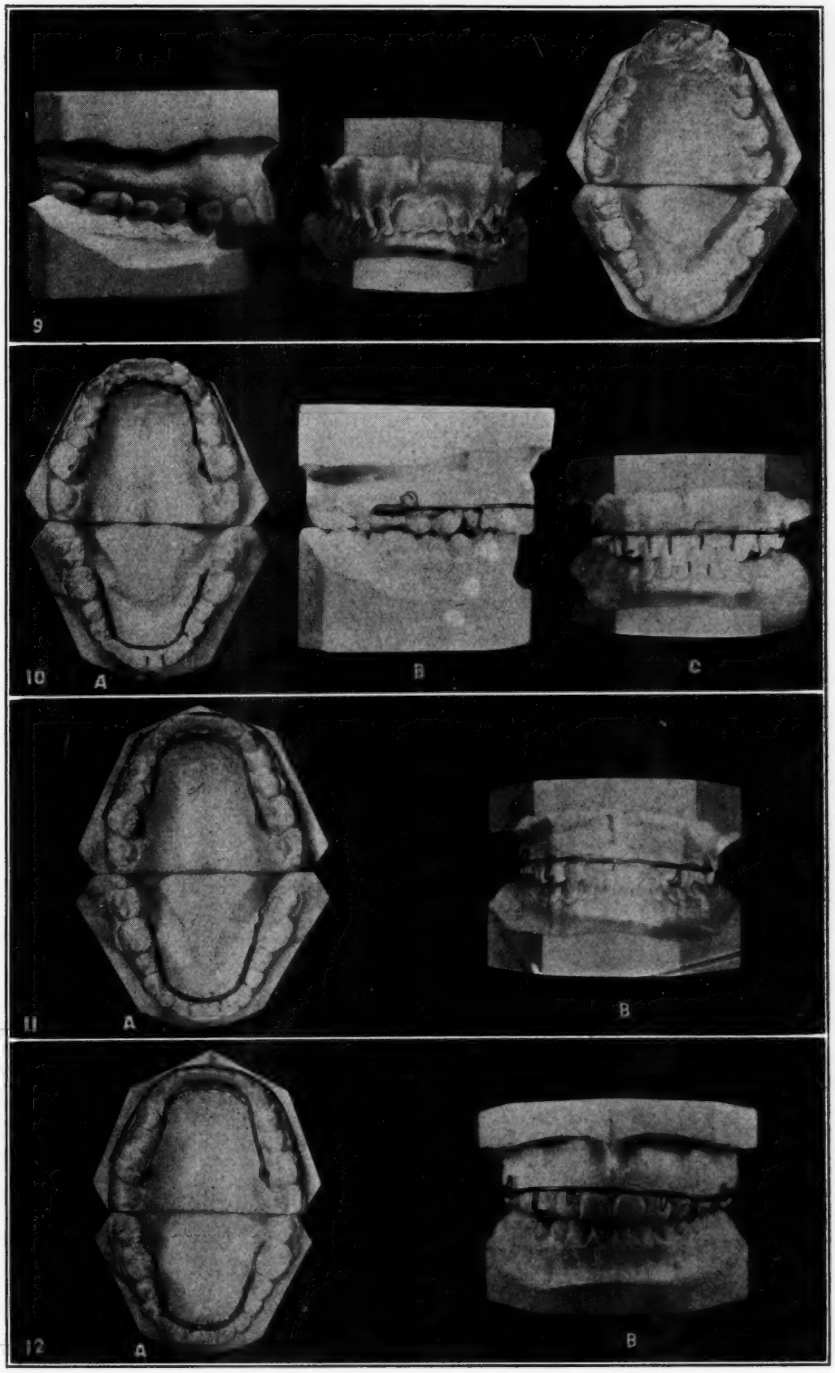

Figs. 9-12.

amount of the distoclusion that has been corrected. Intermaxillary hooks were soldered as in the previous appliance. The patient wore this appliance for about six months when it was found necessary to construct a new appliance.

A new lingual appliance was constructed in the mandibular arch lying close to the lingual surfaces of all the teeth. A new guide plane was constructed in the maxillary, this being made as in the previous models, only it was made steeper in order to bring the teeth into exact normal position, as shown in Fig. 12 *A*. Extensions were necessary for the lateral incisors in order to depress them slightly, as shown in Fig. 12 *B*. You will also notice the normal position of the teeth in this picture.

It has been shown that by the use of the guide plane extreme cases of distoclusion may be corrected in a much shorter time than by the use of only intermaxillary elastics. It places the jaws in a normal relationship opening the bite to allow the teeth to erupt much faster than in ordinary cases, thus shortening the treatment considerably. A thorough test has shown that these teeth remained in the proper position after all appliances have been removed. We consider it a most useful adjunct in the treatment of closed bite and distoclusion cases. We are sorry that a more detailed explanation cannot be given of the construction of this guide plane; however, it is absolutely necessary for it to be constructed accurately in order to accomplish the desired results.

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THE USE OF RUSTLESS STEEL IN DENTOFACIAL ORTHOPEDICS*

DR. LUCIEN DE COSTER, BRUSSELS, BELGIUM

Professor of Orthodontia, Belgian Institute of Stomatology

THROUGH the natural evolution of the science of orthodontia and the increasing appreciation of the biologic facts involved in orthodontic therapeutics, mechanical treatment has been removed from the prominent place it occupied for so long a time. The therapeutic problem has become a biomechanical one. The main factors of this biomechanical problem may be stated as the problem of the therapeutic forces and the problem of anchorage.

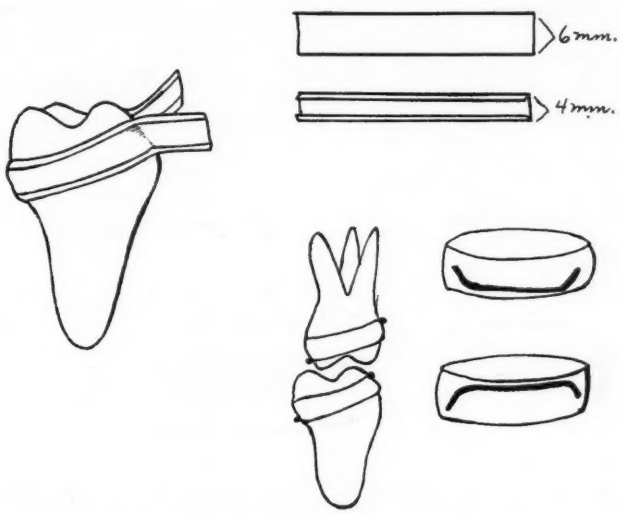


Fig. 1.—The band making technic.

Practically, the first question can be summed up as the pursuit of the greatest amplitude of movement by the slightest amount of force. The second problem involves the division of the anchorage stresses over all the teeth.

We can satisfy these conditions in several ways: (1) by reducing the active forces of the appliances either by diminution of size of the wires or by lengthening the wires; (2) by avoiding all latent movements of forces; (3) by rendering, when possible, the whole force of the appliances effective; (4) by acting rather by pressure than by traction; (5) by acting on groups of teeth rather than on separate teeth; (6) by using tangential instead of rigid and fixed anchorage.

In reference to theoretic conceptions, I venture to say that the rustless

*A demonstration given at the Second International Orthodontic Congress, London, July, 1931.

steel technic will take a principal place in orthodontic therapeutics. The peculiar advantages of rustless steel may be stated as: :

(1) It is particularly strong; its strength is double that of gold.

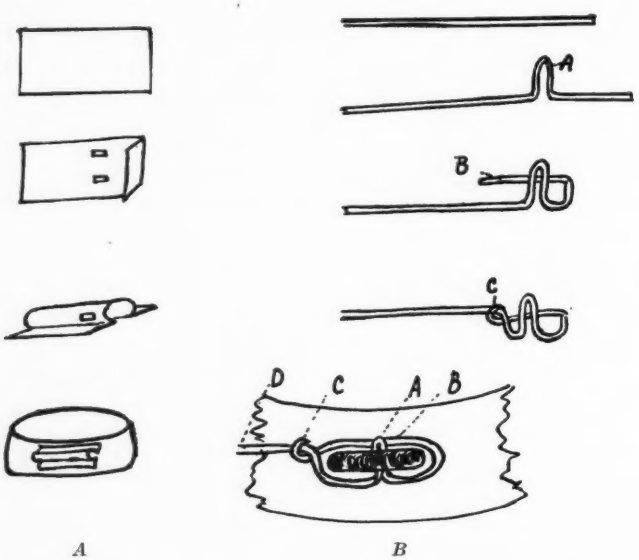
(2) It is practically unbreakable.

(3) It has a high degree of elasticity.

(4) It has an oligodynamic and antiseptic property.

Since 1924 I have used rustless steel in orthodontia. Several times I have explained my own technic before the leading societies of Belgium. In 1926 I presented a demonstration at the Stomatological Congress at Paris, in 1929 at the Dentofacial Congress at Lyons, and in 1930 at the Italian Stomatological Congress at Venice.

The greatest progress in the use of rustless steel has been the use of electric welding for the assemblage of the various appliances. This welding technic



A *B*

Fig. 2.—The lock bending technic: (*A*) female part; (*B*) male part.

permits one to make bands, to fix auxiliary springs, and to make all sorts of appliances just as well as gold ones.

The electric welding outfit I use is that devised by Charlier of Brussels and constructed by the Belgica Manufacturing Co.

TECHNIC OF BAND CONSTRUCTION

Out of a strip of Planox metal (0.07 mm. thick) a strip is cut 6 mm. broad. (Fig. 1.) The margins are recurved at a height of 1 mm. The upper and also the outer margins consequently will be of double thickness, the center of the strip being a single thickness. The whole strip is contoured and passed over the tooth. The double upper and outer parts will thus lie above and outside the contact point; the middle and single part resting at the contact point. This edge will prevent the band from slipping off and pressing on the gums.

A well-fitting band cannot slip off or press into the gums except when one of the margins becomes enlarged under the stress of mastication. In order to

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prevent these accidents a little wire is welded at these margins, i. e., gingivolingual and vestibulo-occlusal margins for the mandibular teeth; gingivovestibular and linguoclusal for the maxillary teeth.

The incisor, canine and premolar bands are made the same way.

TECHNIC OF LOCK CONSTRUCTION

All sorts of locks may be welded. Personally I prefer to construct a lock which I have used on a large scale for many years.

For its construction only the usual plate of Planox and the base wire of the arch are needed. (Fig. 2.) In a small coin of Planox 1 × 0.08 cm. in size, two square holes are pierced. This coin is folded over a small wire so as to make a little groove with the two holes placed one above the other. Each end of the little tube formed by welding this groove on the band must be flattened.

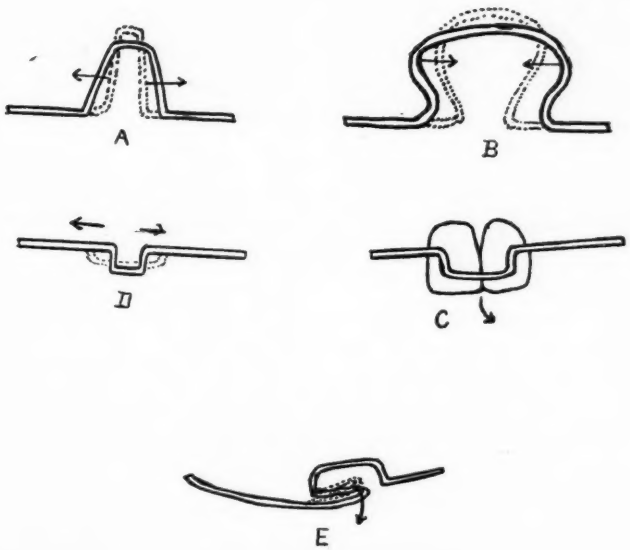


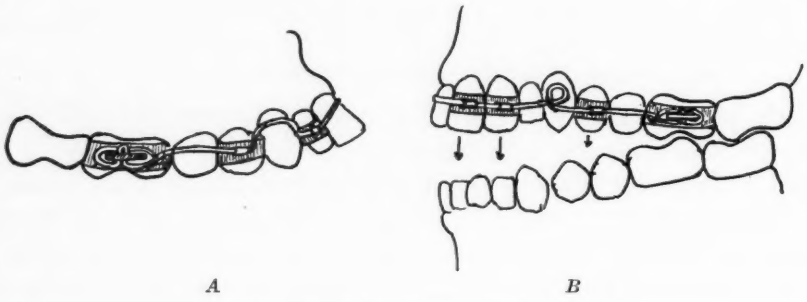
Fig. 3.—Varieties of loops used with vestibular arches: *A*, anteroposterior expansion loop; *B*, anteroposterior contraction loop; *C*, vertical loop used as a finger spring; *D*, little vertical loop used for anteroposterior expansion; *E*, horizontal loop used for anteroposterior movement of a single tooth.

As for the male part of the lock, it will be made by bending the main arch wire. When all the bends are made, the whole male part is flattened by a hammer, and it is contoured so that it embraces the whole convex face of the tooth. The part *A* passes through the two holes like a rod in a tube. Part *B* must lie behind *A* (that part which crosses the holes). The *C* loop must embrace the anterior part of the main arch *D*.

TECHNIC OF ARCH CONSTRUCTION

The Vestibular Arch.—The first arch in rustless steel that I constructed was a vestibular arch. Its whole advantage was its extraordinary elasticity. Its peculiarity was the construction of elastic loops. We must distinguish several forms of loops (Figs. 3 and 4): (1) the great vertical loops used for traction and also for pressure; (2) the little vertical loops used as extension loops or as

finger springs acting by torsion; (3) the horizontal loops used as auxiliary springs in the horizontal plane; (4) the full loops used for movements in the vertical plane.



A *B*

Fig. 4.—*A* and *B*, upper vestibular arch.

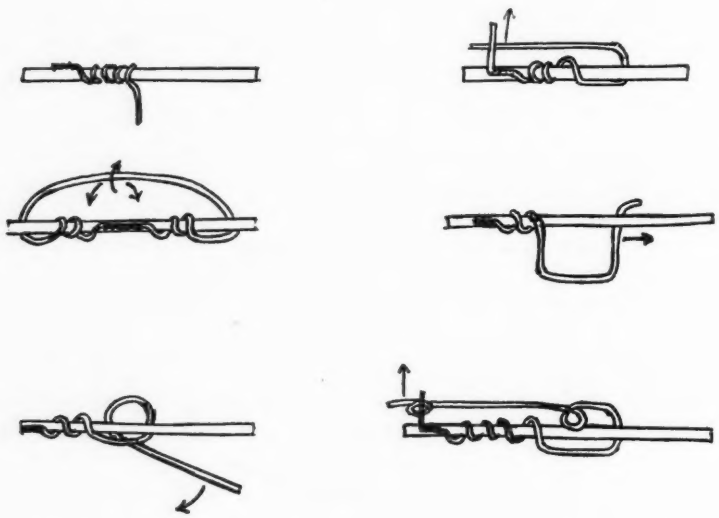


Fig. 5.—Varieties of auxiliary springs used with lingual arches.

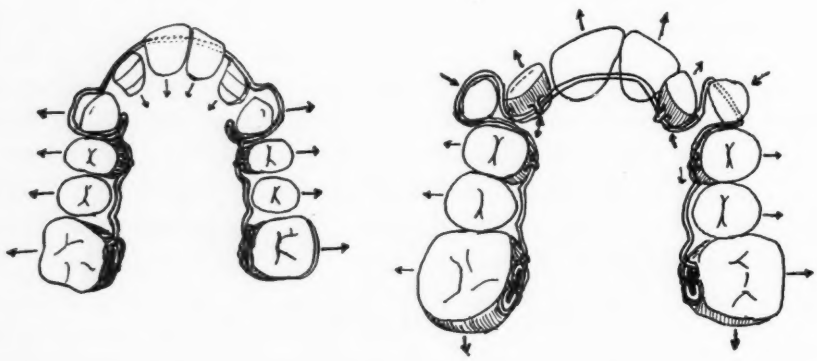


Fig. 6.—Linguovestibular arches.

The Lingual Arch.—It is possible to construct lingual arches without soldering or welding. Nevertheless, the welding technic is a great advantage in the construction of auxiliary springs and of all sorts of appliances (Fig. 5).

The technic of welding an auxiliary spring to a base wire is very simple. The smaller wire is flattened and also the larger, in order to offer a greater surface to the passage of the current. The electrodes must not crush the wires by welding. After welding, the small auxiliary spring is wrapped around the base wire.

The Linguovestibular Arch.—The technic of the elastic wire loops on vestibular arches and the necessity of complying with the theoretic conditions of biomechanical treatment have led me to elaborate a special technic which combines the advantages of the lingual and vestibular arches. (Fig. 6.)

Its special features are that a lingual arch has anteroposterior springs bent in the main arch itself; a vestibular arch has lingual springs bent in the main arch. This latter is so bent as to produce an anteroposterior spring by linguovestibular loops. Its length is greatly increased and so diminishes the active force without reducing its range of movement. It is divided into different sections corresponding to different types of forces required. The action of these various sections may be effective in various planes and cannot produce unexpected results. It only acts by pressure and may be said to be almost automatic. The whole appliance can be readjusted by a simple bending of the loops.

The anchorage is a tangential one, and all the teeth take their proper share in the reaction.

TECHNIC

On any given case we must first study the balance of possible forces, so as to have an equilibrium of reactions and springs. On a plaster model, we construct a preliminary appliance by using a brass wire, or a wire of a very small diameter. The steel wire will be bent in the same way as the brass wire. Terminal locks must be provided and also bands, hooks or tubes on each tooth where they seem necessary.

The appliance acts almost automatically and subsequent visits can be made every two months. At these visits the loops can be enlarged or reduced as necessary without changing the direction of the arch, by using a large pair of pliers. I believe the accompanying drawings will explain the many advantages of the use of this material.

DEPARTMENT OF
CHILDREN'S DENTISTRY

FIFTH ANNUAL MEETING OF THE AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN

WALTER T. MCFALL, D.D.S., MACON, GA.

THE Fifth Annual Meeting of the American Society for the Promotion of Dentistry for Children was held at the Hotel Statler, Buffalo, N. Y., on Monday, September 12. This is the only organization of national and international scope devoting its full support to the advancement, interest, and improvement of dentistry for children. The officers for 1931-1932 were: Dr. S. D. Harris, Detroit, president; Dr. Thaddeus P. Hyatt, New York City, president-elect; Dr. Charles A. Sweet, Oakland, Calif., secretary-treasurer. An executive committee composed of the officers and Dr. F. Blaine Rhobotham, Chicago; Dr. Floyde E. Hogeboom, Los Angeles, and Dr. Haidee Weeks, New Orleans, served during the past year and rendered splendid services to the organization and the work it aspires to do. The major committees of the organization are: program, Drs. T. P. Hyatt, W. H. Mork, Theodor Blum; publications, Drs. F. B. Rhobotham and George H. Wandel; study clubs, Drs. John E. Gurley, F. E. Hogeboom, and Charles A. Sweet; college, Drs. Arthur R. McDowell, H. E. Friesell, Leroy M. S. Miner; nomenclature, Dr. Alfred Walker.

Practical, interesting, and most helpful table clinics were given from 9 to 11 A.M. by the essayists and clinicians: "Normal and Abnormal Growth Changes of Deciduous Dentitions and Their Relation to the Practice of Preventive Dentistry," by Dr. Frederick Lester Stanton, Professor of Preventive Dentistry, New York University Dental College; "Diet for Children," by Dr. W. A. Cotton, Preventive Dentistry Clinic, New York University Dental College; "An Improved Technic for Proximal Caries in Deciduous Molars and Canines as Advocated by Dr. R. C. Willett of Peoria, Illinois," by Drs. C. V. Lehman and C. S. Foster of Cedar Rapids, Iowa; "Preventive Dentistry for Children," by Dr. Walter Briggs, Attleboro, Mass.

During the afternoon, the following papers were given: "Preventive Dentistry—A Stock Taking," by Dr. Frederick L. Stanton, New York University Dental College; "Operative or Preventive—Which Procedure?" by Dr. Harry S. Thomson, Field Secretary, Canadian Dental Hygiene Council; "Questionnaire," by Dr. Haidee Weeks, New Orleans; "The Liability of Different Surfaces of Teeth Among School Children," by Dr. H. Shirley Dwyer, Brooklyn, N. Y.; "Oral Hygiene Activities of the Department of the State of New York," by Dr. C. D. Van Alstine, Albany, N. Y.

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On Thursday, September 15, a delightful and enjoyable business luncheon was given in the Iriquois Room of the Hotel Statler. Important business was transacted; committee reports were read, approved and accepted. Several very important resolutions were presented, and their knowledge and acceptance by the dental profession everywhere would do much to help in the ideal that all good dentists have for their profession, that of eliminating the manifold causes necessitating dentistry, extensive and hard to replace corrective phases of their work in later life.

Officers elected for 1932-1933 are: Dr. Thaddeus P. Hyatt, New York City, president; Dr. Haidee Weeks, New Orleans, president-elect; Dr. Charles A. Sweet, Oakland, Calif., secretary-treasurer.

RESOLUTIONS OF THE AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN*

THE American Society for the Promotion of Dentistry for Children subscribes to the following affirmations of items and principles relating to dental health:

WHEREAS, the correction of malocclusion is primarily a health measure; and

WHEREAS, the only solution of dental health, both locally and in its relation to general health, lies in the prevention of oral disease; and

WHEREAS, dental prevention is effective in inverse ratio to the age of the patient, children's dentistry is the logical field of preventive measures; and

WHEREAS, the orthodontist needs the complete cooperation of the dentist to insure and maintain dental health before and during orthodontic procedure; and

WHEREAS, the principles of prevention, listed herewith, have been endorsed by fifteen state dental conventions, three national dental associations, and the Federation Dentaire Internationale; namely:

Proper attention to initial defects,

Particular care and attention to all pits, fissures and grooves before caries appears,

No cavity is too small to fill,

The deciduous teeth should have the same care and attention as the permanent ones, as their maintenance in health is essential to the proper development of adult occlusion; and

WHEREAS, disregard of these principles and practices of accepted dental teachings constitutes a transgression of professional obligation to the patient and a serious handicap to orthodontic procedure; therefore be it

Resolved, That this declaration of policy is the unanimous expression of the belief of this organization, whose members are called upon to uphold it in all their relations with the dental profession and the public; and be it further

Resolved, That these resolutions should be displayed in each orthodontic office and a copy sent to the dentist responsible for the care of the patient immediately on the acceptance of a case; and be it further

Resolved, That this action be given publicity in professional journals and copies sent to the secretaries of various state, national and international dental organizations and to dental school associations.

WHEREAS, agencies caring for children have no definite policy concerning care of children's teeth; and

WHEREAS, many thousands of children throughout the United States are under the care of such agencies; and

WHEREAS, an opportunity is presented for promoting better health through preventive dentistry particularly among the youngest children where the greatest good can be accomplished, be it

Resolved, That the American Society for the Promotion of Dentistry for Children urge all organizations caring for children either in institutions or in foster

*Passed at the fifth annual meeting of the Society, Buffalo, N. Y., September, 1932.

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homes to adopt a minimum standard of dental care such as the one outlined in the "Standard Procedure for Treatment of Dental Clinic Patients" worked out by the Associated Out-Patient Clinics Committee of the New York Tuberculosis and Health Association and also to adopt the following policy:

POLICY

Dental Care for Children in Institutions and Foster Homes

Dental care should be provided for all children between the ages of two and fourteen years, especially the youngest children (preschool group) because of the:

1. Benefit to health.
2. Preservation of teeth in position in order to maintain ability to chew effectively and painlessly.
3. Preservation of the dental arch.
4. Minimum expense.

The normal growth of the jaws is disturbed by premature loss of the deciduous (first or baby) teeth thereby tending to cause crowding of the permanent teeth and deformity of the adjacent bones of the nose and head.

Not only from the standpoint of health but also from the standpoint of economy, the filling of tiny pits, fissures and cavities saves the deciduous teeth, thereby allowing the jaw to develop normally and possibly obviating the later expense of orthodontia and nasal operations.

The filling of the tiny breaks in the enamel of the first permanent teeth (especially first permanent molars) to erupt is also of advantage economically because of the time and cost necessary to take care of the extensive caries in the child of school age.

The necessary dental care may be obtained by service:

1. Provided by the organization in the institutional building or administrative headquarters.
2. In private offices of dentists, the fee being paid by the institution.
3. In public clinics.

WHEREAS, it is an accepted fact that childhood is a very critical period in the growth and development of the individual; and

WHEREAS, the condition of the deciduous teeth is of the greatest importance to the health of the child; and

WHEREAS, the term "temporary" or "baby" implies or suggests something unimportant and transitory, and when applied to the deciduous teeth creates in the mind of parents and the general public the belief that these teeth are unimportant;

WHEREAS, the neglect of these deciduous teeth not only is dangerous and detrimental to the health of the child, but also creates difficulties for the dentist to overcome in giving these teeth efficient and proper care; therefore be it

Resolved, That all oral hygiene committees be requested to use only the term "deciduous teeth" in all their campaigns for public education, either by lectures, radio talks or printed matter. That editors of all dental journals be requested to change the terms "temporary" or "baby teeth" to "deciduous" whenever present in articles submitted for publication in their journal, and be it further

Resolved, That copies of these resolutions be sent to every oral hygiene committee in the country, to editors of all dental journals throughout the world, to the secretaries of all state and local dental societies, and all health organizations and those devoted to children's welfare.

LETTER TO THE MEMBERS OF THE AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN

IN LOOKING over the history of our profession, from the early days of Egyptian civilization to the present time, we find no record of special dental service being devoted to children. We find no evidence of work being done on children's teeth, though there are many evidences of dental work having been done for adults. We do not find in the writings of those days any reference to a special or different procedure being advocated for children. There is no greater contribution that the dental profession can give to the people of today, and none which will have a more potent influence on the health, happiness and intelligence of future generations, than to preserve and to maintain the health and integrity of the mouths of the children.

Having publicly assumed the obligation this Society places on us, namely, to promote the best that dentistry can give to children, we cannot shirk, nor may we evade, the moral responsibility this places on our shoulders. What is this obligation we have accepted? What are the responsibilities placed on us by the acceptance of this obligation?

The first obligation we accepted when adopting the name of our organization, "A Society for the Promotion of Dentistry for Children." Therefore, each of us must study and suggest how the Society can best promote this phase of dentistry. Each and every member is asked to offer one or more suggestions.

What are the responsibilities?

Having formed an organization for the promotion of a very definite phase of dental service, it is our responsibility to ascertain and to secure the latest and most scientific data on this subject; to pass this information on to our members; to encourage research work along these lines; to endeavor to secure funds for this purpose; to ascertain what course and what type of instructions are given in the colleges, so that we may offer constructive aid if it is needed.

Those of us who are placed in positions where the handling of many hundreds of children is possible, have a grave and serious responsibility from a scientific point of view as well as from the moral point of view. The repair of damaged teeth and the removal of teeth that cannot be saved, have been done, and can be done, today, tomorrow, and forever by the individual dentist, with no real progress to the betterment of our knowledge as to the best procedure to be followed.

However, those of us who have the opportunity to direct the work of many dentists and who handle hundreds and thousands of children, have a far greater opportunity and therefore a greater moral responsibility to the profession as well as to the Society. To these members is given the privilege to secure accurate and scientific data; they also have the material for ascertaining the benefits or dis-

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advantages of certain definite and well thought out procedures. It is to these members of the Society more than to the individual practitioner that we shall look for reliable and scientific advances in the practice of dentistry for children. The Society recognizes these opportunities and the moral obligation placed on these members, and it confidently and eagerly awaits the reports of their work.

By studying and thinking over our obligation and its responsibilities we shall see how important is the work that lies before us. As we better appreciate the social and economic value of this work, it will and must instill a fervent desire in every one of us to "carry on."

My fellow officers and myself accept the honor you have conferred on us, and we also accept our share of the responsibilities. We are keenly aware of the responsibility you have taken on yourselves in placing us in these positions. Your officers can do but little without your support. They are elected to carry out your instructions. These instructions should be carefully formulated and well defined. It is our intention to keep in close touch with each member during the coming year.

I am thoroughly aware of the fact, that, as your President, I can but serve as the channel between the individual member and his relation to the Society as a whole. In the name of all your officers I assure you that it shall be our task and also our pleasure to fulfill our duties to the best of our abilities, and we ask every member to support the officers of the Society to the utmost of his time and opportunity, for the sake of those little ones whom we all love so sincerely.

Thaddeus P. Hyatt, President.

DIET FOR CHILDREN*†

W. A. Cotton, D.D.S., New York, N. Y.

THIS chart is not a "diet" nor is it intended as a cure for disease. It is a guide to correct eating and an aid to health.

By its use you may enjoy your favorite foods in their compatible relation with other foods.

Good foods, improperly prepared, and in wrong combinations, produce acid and are materially reduced in their nutritive value.

Vegetables should never be cooked in open utensils, because the oxygen in the air oxidizes the organic mineral salts, rendering them useless. It also kills the vitamins. Vegetables should be steamed or cooked under pressure.

The stomach of the average person has become accustomed to being punished by eating starches with fruits and proteins at the same meal. The lack of pain does not mean that it is right. Starches when eaten with fruits or proteins produce fermentation and acid toxic end-products, which overstimulate the secretions of the stomach.

For some people it is not advised to discontinue this wrong practice suddenly, or all at once, for the secreting glands of the stomach have no way of knowing that you have learned better, and will continue, according to habit, to pour into the stomach digestive juices that are not needed. This usually produces a gnawing feeling, which is thought to be hunger. A glass of water usually relieves this, or lemon juice added to the water. One may even feel faint or the head may ache. This is not from lack of food but from the lack of the stimulation of the alcohol, from the customary fermentation and the acid end-products.

In like manner few can discontinue the use of tobacco without unpleasant feelings and a strong demand for the weed.

It is suggested that those who cannot change their wrong eating habits at once do so gradually, for the body will return to normal if given a chance.

When you have mastered the art of correct living you will not return to your old disease producing ways.

There are at least six factors necessary to maintain a healthy body.

1. Pure foods.
2. Pure air.
3. Pure water.
4. Sunshine.
5. Exercise.
6. Mental attitude.

*This chart was distributed at the Fifth Annual Meeting of the American Society for the Promotion of Dentistry for Children, Buffalo, N. Y., Sept. 12, 1932. Copyrighted, 1931, by W. A. Cotton, New York. Reprinted by permission of Dr. Cotton.

†From the Preventive Dentistry Clinic of New York University Dental College.

Life can only be continued by the food we eat; these foods must be supplied as nature grew them, with *nothing removed and nothing added.*

Do not eat any processed or refined foods.

Do not eat refined sugar.

Do not eat refined white flour.

Do not eat manufactured jams and preserves, chemically colored and flavored.

Do not use vinegar; use lemon juice.

Do not eat when angry, tired, excited or disturbed. Eating should be a peaceful performance.

Do not eat food that will "keep" any length of time, for when a microbe, a bug, a worm, or a mouse will not eat it, you may be sure it contains but little nourishment.

Do not take iced drinks, or iced milk. Your stomach is a highly sensitive secreting membrane, and should not be chilled.

Eat a large portion of raw salad twice a day.

Eat only when hungry.

Do not take any orange or other fruit juices at the same meal with starches, such as toast, cereals, bread, etc.

In planning your meals the following method has been found most satisfactory for the average person, but can be changed to suit individual needs as long as the correct combinations are maintained.

The most suitable breakfast is one of raw ripe fruit and milk, except melon, which cannot be eaten with milk.

The lunch may be of starch with any of the vegetables in Group 2 and a large raw salad with any of the salads of Group 2, but must not contain any of the foods in Group 3.

The dinner may be a choice of any of the proteins in Group 3 and any of the vegetables of Group 2.

A large salad made up from these two groups.

Suggestions

BREAKFAST

Orange juice and any fruit in season, if milk is taken, then no melon. Coffee.

LUNCH

Baked potato, or brown rice or whole wheat bread and rolls and any of the vegetables in Group 2.

A large salad.

DINNER

Any of the meats or fish in Group 3 with any of the vegetables of Group 2. A large salad from Groups 2 and 3.

If soup is desired it can be made from any of the nonstarchy vegetables and flavored with any of the soup flavorings or herbs.

Take your fruit juices alone or one hour before starches are eaten.

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Always remember to eat four times more of the red foods than you do of the blue foods.

GROUP 1

SUGARS

Slightly Acid Forming
Brown sugar
Molasses

Maple sugar
Maple syrup
White sugar is deficient. Do not eat

STARCHES

Acid Forming
White flour is deficient. Do not eat
All preparations of the whole grains of Barley, Buckwheat, Corn, Sweet Corn (twenty-four hours old), Oats, Rye, Rice, Wheat
Pumpkin
Winter squash

Potatoes (Irish and sweet)
Acid forming if eaten without the skins
Alkaline forming if eaten with the skins
Bananas (ripe)

It is best to eat only one kind of starch at a meal when starches are eaten.

Dried beans
Dried peas
Peanuts
Chestnuts
Lentils

Contains a high per cent of protein and starch. A difficult digesting combination. Should not be eaten.

GROUP 2

Meals should be planned around the vegetables, fruits and salads as the main foods.

All foods printed in blue are acid forming, the red are alkaline forming, and the black are neutral.

Eat four times more of the red alkaline forming foods than of the blue acid forming foods.

Eating the foods in red make for cheerfulness, red blood, pep, and pink cheeks by building up and maintaining a high alkaline reserve.

A diet in which the blue foods predominate will make the body acid and the disposition blue.

VEGETABLES FOR A SQUARE MEAL

Alkaline Forming

Artichokes
Asparagus
Beans (fresh green)
Beets
Broccoli
Brussel sprouts
Carrots
Celery
Cauliflower
Corn (new, first day picked)
Chives
Egg plant
Kohl-rabi
Leeks
Mushrooms
Onions
Oyster plant
Okra
Parsnips
Peas (fresh)
Radishes
Rutabagas
String beans
Turnips

GREENS

Beet tops
Chard
Dandelion
Celery
Horse-radish
Kale
Parsley
Spinach
Turnip tops
Watercress

SALADS

Avocado
Cabbage (raw)
Chicory
Cucumber
Dandelion
Endive
Escarole
Field salad
Horse-radish
Lettuce
Romaine
Sauerkraut
Spinach
Watercress

FATS

Bacon
Butter
Cream
Olive Oil
Lard

Can be eaten with any group.

honey (neutral)
Oleomargarine
Corn Oil
Cotton Seed Oil
Peanut Oil

Refined, eat sparingly.

SWEET FRUITS

Alkaline Forming

Bananas (very ripe)
Dates
Figs
Raisins

Can be eaten with any group.

GROUP 3

FRUITS

Alkaline Forming
(If eaten without sugar)

Apples
Apricots
Berries
Cherries (sweet)
Citron
Currants
Grapefruit
Grapes
Lemons
Limes
Melons (eaten alone)
Oranges
Peaches
Pears
Persimmons
Pineapple
Quince
Strawberries
Tangerines
Tomatoes (love apple)
Olives (ripe)

PROTEINS

Acid Forming

Cheese
Clams
Oysters
Fish
Scallops
Shrimps
All meats
All game
All poultry
Gelatine
Nuts
Egg (yolk)
Egg (white)

It is better to eat only one kind of protein at a meal when protein is eaten.

(Not advised)

Sour milk
Butter milk
Whole milk

Milk is a food not a drink. Better taken with raw vegetables and fruits. Should be sipped.

Rhubarb
Plums
Prunes
Cranberries

These contain excess of organic acids. Not advised for most people.

XUM

ORAL HYGIENE ACTIVITIES OF THE EDUCATION DEPARTMENT OF THE STATE OF NEW YORK*

CHAUNCEY D. VAN ALSTINE,† D.D.S., ALBANY, N. Y.

IN PRESENTING this subject it will be my endeavor to emphasize the opportunities of the schools to teach prophylactic measures to children and of the family dentist to stimulate parents to give more attention to dental conditions.

The oral hygiene program in the schools of this state is recognized as a state function. Its adoption as such dates from December 7, 1910, when Dr. Eugene H. Porter, then State Commissioner of Health, appointed two dentist members of the State Dental Society as lecturers on oral hygiene, Dr. Herbert L. Wheeler of New York City and Dr. William A. White of Phelps, N. Y. The services rendered by these two dentists became very popular and were in great demand from the beginning. At the expiration of the first year two more dentists also recommended by the State Dental Society were added to the staff, Dr. W. W. Belcher of Rochester, N. Y., and Dr. T. C. Hyatt of Brooklyn. Demands for services from the schools of the state so rapidly multiplied that at the expiration of the second year the State Commissioner of Health appointed a full-time lecturer on oral hygiene. His services as such were continued until 1914.

To Dr. William A. Howe, then State Deputy Commissioner of Health, now Chief of the Medical Inspection Bureau of the Education Department, belongs much credit for this recognition of oral hygiene as a state function and its introduction into the educational system of the state. In 1918 he presented this subject to the American Dental Society at its twenty-second annual meeting in Chicago. That was fourteen years ago. From its inception he quickly recognized the great need of better attention to the dental equipment of children and fully appreciated that the most effective way in which to deal with this important health problem would be found in education.

By legislative enactment the Medical Inspection Law became effective on August 1, 1913. It provides a broader service than its name implies, that of health supervision and health education. It stands for an annual medical examination of every school child under its provision for the relief of physical or dental defects by the family physician or family dentist and for preventive medicine and dentistry as applied by the medical and dental professions. The law requires the employment of a medical inspector in every school district in the state. It permits the employment of dentists, dental hygiene teachers, nurse teachers, nutritionists and other specialists to maintain supervision over the health of the school children of the state. September 1, 1918, a full-time supervisor of oral hygiene was appointed in the New York State Education Department.

To enable school authorities throughout the state to employ nurses and hygienists properly qualified to carry on the work, definite postgraduate qualifica-

*Read before the Fifth Annual Meeting of the American Society for the Promotion of Dentistry for Children, Buffalo, N. Y., September 12, 1932.

†Supervisor of Oral Hygiene, Education Department, State of New York.

tions were established by the State Department of Education. When such qualifications are met by either the nurse or the oral hygienists, they are given certificates as either nurse teachers or dental hygiene teachers. By this plan boards of education are privileged to employ either one or both, as they engage any other teachers in the school system. In other words, they are exempt from state or local civil service requirements. These nurse teachers and dental hygiene teachers also enjoy the same tenure of office as do other teachers, become automatically members of the State Teachers' Retirement System and share in the privileges of the retirement system of the state.

The Teacher Training Division of the State Department of Education has established the following regulations governing dental hygiene teachers and dental supervisors:

Dental hygiene teacher is the official designation for a dental hygienist employed in school health service and who meets certain qualifications.

Dental supervisor is the official designation for a dentist so employed. The only qualifications are state license to practice dentistry and annual registration with the State Board of Dental Examiners. No certificate is issued for this position.

A certificate as dental hygiene teacher is issued to those meeting the requirements, only on application of a superintendent of schools of a city, village or district or the head of an institution. Application blanks are supplied by the Teacher Training Division.

Permanent certificates are issued only to high school graduate, registered, dental hygienists who present "credentials showing completion of at least twelve semester hours' work in approved professional courses in health education and two years' successful experience as a dental hygiene teacher."

To meet these qualifications established by the State Department of Education a summer course for oral hygienists was established in 1925 at the Oswego Normal School. At the first session seven hygienists were in attendance. In 1926 the course was transferred from Oswego to the Dental Department of the University of Buffalo. Only four hygienists attended this course. In 1927 the course was repeated with seven students. In 1928 the course was transferred from the Dental Department at the University of Buffalo to the State Teachers College at Buffalo. The course this year was attended by twenty-three students. Each year since then the course has been repeated with the following attendance: in 1929, twenty-eight students; in 1930, sixty-eight students; in 1931 eighty-nine students, and in 1932, eighty-seven students.

The term is six weeks long, extending from about July 1 to August 15. Attendance at two summer sessions is required for the full twelve-semester-hour course. The first year group takes introduction to education, child health, applied oral hygiene. Public speaking and poster work are units of applied oral hygiene. The completion of these subjects entitles the student to six semester hours' credit or a limited certificate which is good for three years.

Before the certificate expires it is necessary for the hygienists to take the second-year course of subjects comprising mental hygiene, social work problems and nutrition, which carry six semester hours' credit and entitles one to a permanent certificate as dental hygiene teacher.

So far as I know New York State is the pioneer state in requiring or giving postgraduate instruction leading to certification of dental hygiene teachers. Hygienists from Florida, Pennsylvania, Vermont, Massachusetts, and Illinois have taken the course during the last three years. The subjects are presented from the viewpoint of their application to school health service and the correlation of oral hygiene teaching with that of the general school curriculum. For the past fourteen years the Oral Hygiene Supervisor of the New York State Department of Education has been conducting a campaign of education directed to the care of children's teeth. The examination of the mouths of millions of school children disclosed the fact that over 75 per cent of them have decayed teeth. This is more than all other combined physical defects found. In the World War bad dental conditions ranked second in the cause of rejection.

The school child's first assistance in health came with the school nurse and social service worker who paved the way for medical inspection and dental attention. Physical education, the playground, diet and nutrition supervision then followed.

This school health service opened a new field for the dental hygienist. Today she occupies one of the leading positions in the health program of the public schools. Parochial schools are also availing themselves of their services. A notable example was that of Watertown, N. Y., under the direction of Dr. E. I. Harrington. Just as the nurse quickly demonstrated the need and value of her services, so has the dental hygienist become a recognized factor in every successful school health program. She not only cleans the teeth of children but teaches them prophylactic measures for the preservation of good dental conditions. She bears the same relation to the dental profession that the trained nurse bears to the medical profession. The idea of allowing trained women to clean teeth was first advocated in 1902. The idea rapidly grew in favor. In 1926 there were 40 dental hygienists teaching oral hygiene in the schools in New York State not including those in New York City, Rochester and Buffalo. In 1930 there were 125 employed, or an increase of 320 per cent in four years. In a recent survey of work as now conducted in the schools of New York State the superintendents were found to be unanimous in their approval and were strong for its continuation and extension.

While the dental profession is cognizant of the importance of prevention, it has little time for more than reparative work. The busy dentist lacks time in which to instruct the public in the proper care of the mouth and the correct *diet* to insure sound teeth and to prevent decay.

The State Dental Society has generously responded to meet this need through its Oral Hygiene Committee. It employed the first hygienist to work in schools in the fall of 1922. The schools then paid $25.00 per week for her services. During the first year six schools employed her for approximately seventy-three days for the school year. During the school year 1925-26, four hundred days of service were rendered and 6400 children had their teeth cleaned, while from May 1, 1930, to May 1, 1931, 42,367 children were examined and 40,053 were given prophylactic attention by the twenty-one dental hygienists employed through Dr. L. A. Timerman, chairman of the Oral Hygiene Committee of the State Dental Society. Their services during this time were rendered in 519 schools. The only solution of the

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problem of dental decay is found in education. Dental caries or tooth decay is largely a disease of childhood. The chief cause of tooth decay is more than a lack of care. It is rather what we eat and how we eat it. The school is the logical place to begin to accomplish results. There, large groups are assembled under the auspices that allow uniform inspection and follow-up attention and practical instruction over a period of years that are vital for habit forming. Dental instruction like other phases of education can be taught better to the receptive mind of the child than to the adult whose prejudices are biased and whose habits are formed.

As we all know decayed teeth are the cause of much sickness, it is estimated that 24 million school children in the United States lose 72 million school days a year. A large percentage of these can be traced to defective teeth. Oral hygiene instruction in the schools wherever successfully carried on pays financially, not only in resultant increase in attendance but a large amount is saved in the cost of re-education of retarded pupils which is estimated averages 40 per cent in the United States. It surely is a waste of public funds to try to educate a child who is not in fit physical condition to profit by the instruction.

It can be seen that primarily the work of the dental hygienist is educational, and as a part of the school system her services should be of a demonstrative nature. No numerical standard should be established, for the important basis is the instruction rather than the clinical process of prophylaxis. It is not the policy of the department to stress numbers nor to establish the impression among pupils that it is not necessary to clean their teeth during vacation because when they return to school the dental hygiene teacher will do it for them. Her work is a demonstration from an educational standpoint of the necessity for proper care of the teeth. Individual instruction stressing the reasons and need of a clean mouth while the dental hygiene teacher is actually cleaning the teeth of the pupils is found to be most effective. Toothbrush drills also, where time permits, can be given a whole grade in about five minutes.

Modern oral hygiene properly integrated in the health service of our educational system is already working its contribution to better health, better attendance and scholastic advancement.

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THE CHILDREN'S CHARTER

President Hoover's White House Conference on Child Health and Protection, Recognizing the Rights of the Child as the First Rights of Citizenship, Pledges Itself to These Aims for the Children of America

FOR every child spiritual and moral training to help him to stand firm under the pressure of life.

II. For every child understanding and the guarding of his personality as his most precious right.

III. For every child a home and that love and security which a home provides; and for that child who must receive foster care, the nearest substitute for his own home.

IV. For every child full preparation for his birth, his mother receiving prenatal, natal, and postnatal care; and the establishment of such protective measures as will make child-bearing safer.

V. For every child health protection from birth through adolescence, including: periodical health examinations and, where needed, care of specialists and hospital and treatment; regular dental examinations and care of the teeth; protective and preventive measures against communicable diseases; the insuring of pure food, pure milk, and pure water.

VI. For every child from birth through adolescence, promotion of health, including health instruction and a health program, wholesome physical and mental recreation, with teachers and leaders adequately trained.

VII. For every child a dwelling place safe, sanitary, and wholesome, with reasonable provisions for privacy, free from conditions which tend to thwart his development; and a home environment harmonious and enriching.

VIII. For every child a school which is safe from hazards, sanitary, properly equipped, lighted, and ventilated. For younger children nursery schools and kindergartens to supplement home care.

IX. For every child a community which recognizes and plans for his needs, protects him against physical dangers, moral hazards, and disease; provides him with safe and wholesome places for play and recreation; and makes provision for his cultural and social needs.

X. For every child an education which, through the discovery and development of his individual abilities, prepares him for life; and through training and vocational guidance prepares him for a living which will yield him the maximum of satisfaction.

XI. For every child such teaching and training as will prepare him for successful parenthood, homemaking, and the rights of citizenship; and, for parents, supplementary training to fit them to deal wisely with the problems of parenthood.

XII. For every child education for safety and protection against accidents to which modern conditions subject him—those to which he is directly exposed and those which, through loss or maiming of his parents, affect him indirectly.

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XIII. For every child who is blind, deaf, crippled, or otherwise, physically handicapped, and for the child who is mentally handicapped, such measures as will early discover and diagnose his handicap, provide care and treatment, and so train him that he may become an asset to society rather than a liability. Expenses of these services should be borne publicly where they cannot be privately met.

XIV. For every child who is in conflict with society the right to be dealt with intelligently as society's charge, not society's outcast; with the home, the school, the church, the court and the institution when needed, shaped to return him whenever possible to the normal stream of life.

XV. For every child the right to grow up in a family with an adequate standard of living and the security of a stable income as the surest safeguard against social handicaps.

XVI. For every child protection against labor that stunts growth, either physical or mental, that limits education, that deprives children of the right of comradeship, of play, and of joy.

XVII. For every rural child as satisfactory schooling and health services as for the city child, and an extension to rural families of social, recreational, and cultural facilities.

XVIII. To supplement the home and the school in the training of youth, and to return to them those interests of which modern life tends to cheat children, every stimulation and encouragement should be given to the extension and development of the voluntary youth organizations.

XIX. To make everywhere available these minimum protections of the health and welfare of children, there should be a district, county, or community organization for health, education, and welfare, with full-time officials, coordinating with a state-wide program which will be responsible to a nation-wide service of general information, statistics, and scientific research. This should include:

(a) Trained, full-time public health officials, with public health nurses, sanitary inspection, and laboratory workers.

(b) Available hospital beds.

(c) Full-time public welfare service for the relief, aid, and guidance of children in special need due to poverty, misfortune, or behavior difficulties, and for the protection of children from abuse, neglect, exploitation, or moral hazard.

For *every* child these rights, regardless of race, or color, or situation, wherever he may live under the protection of the American flag.

DEPARTMENT OF
ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

ACUTE INFECTIONS ABOUT THE LIPS*

JAMES BARRETT BROWN, M.D., F.A.C.S., E. W. GROVE, M.D., AND J. E. PITTMAN, M.D., ST. LOUIS, MO.

ACUTE infections about the lips, especially about the upper one, may present important problems of diagnosis and treatment to both the surgeon and the dentist.

A *B*

Fig. 1.—*A*, Boy ten years of age. Four days before admission a pimple appeared on lip, and his mother squeezed it, and from then on swelling and pain progressed; the mother squeezed it again one day before entry. Marked swelling and induration and three or four pointing areas are shown. W.B.C. 16,600; highest temperature 39°. No general debilitation known. Treatment was two x-ray exposures by Dr. Sherwood Moore with complete separation and discharge of the slough within twenty-four hours. This is the best possible reaction to x-ray treatment, and, aside from possibly saving his life, the resolution of the process was several days earlier than if natural separation had been awaited.
B, Five days later.

Etiology and Diagnosis.—The most frequent causes of severe infections are (1) the squeezing of a pimple and (2) ill-advised or ill-timed surgical interven-

*From the Surgical Service of Dr. V. P. Blair, Washington University School of Medicine, and the Oral Surgical Clinic, Washington University School of Dentistry, St. Louis.

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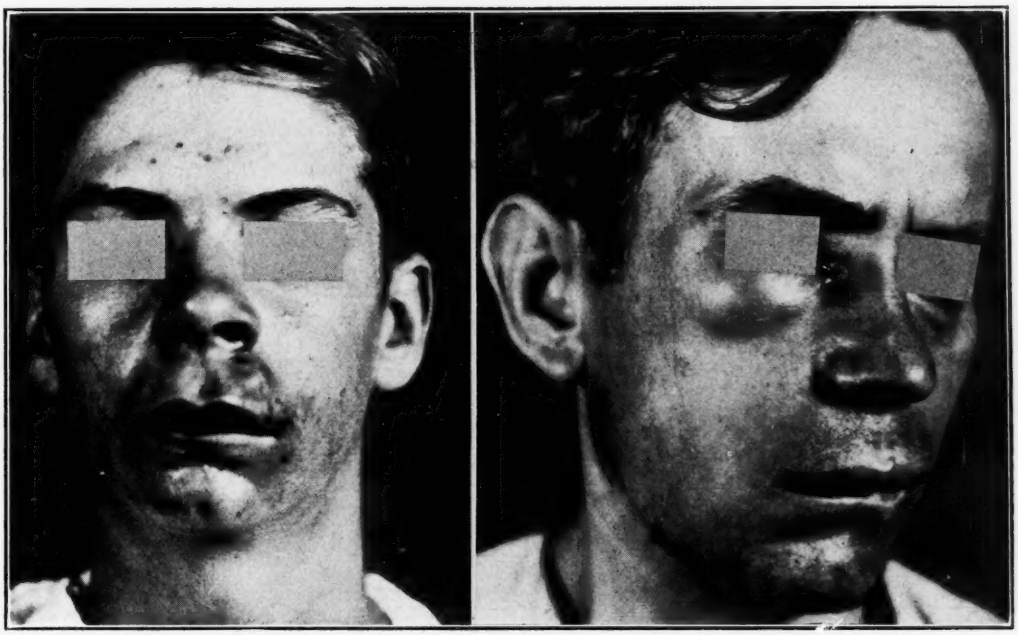
tion in early or moderate infections. In these cases a pimple appears and the patient or some one else squeezes it, probably repeatedly. This leads to dissemination of the infection, and just the slightest trauma, even when the pimple contains free pus may be enough to cause serious spread of the involvement. (Figs. 1 *A* and *B* and 2 *A*.) Other dangerous types of trauma employed too frequently by doctors themselves are small incisions made before localization and cauterization with an applicator of phenol (Fig. 3). There is also a tendency for some to encourage drainage of a small area by frequent picking away of crusts and irritation of the area in general. Any trauma, surgical or otherwise, to a local inflammation in a lip may lead to a severe spreading infection.



A *B*

Fig. 2.—*A*, A boy of sixteen years had had boils for two and one-half months. Three days before admission a boil developed on his lip; he squeezed it, and it became swollen and painful following this. There was no other general debilitation known. W.B.C. 13,000. There is shown a widespread hard infection involving the entire lip. X-ray treatment was given by Dr. Sherwood Moore; there was rapid resolution, and two days later the lip was opened transversely from the inside with the cautery and about 2 c.c. of pus were evacuated. There was rapid subsidence of the infection, and it is felt that, although drainage did have to be done, there was great benefit from the x-ray treatment in bringing about good localization.

B, A man of thirty-two years had a tender maxillary incisor two days before entry, and then a rapid swelling and spread of infection over the face up to the orbit. No other signs of debilitation were found. W.B.C. 15,000. Examination of this patient on the same day as of the patient in Fig. 2 *A* showed almost identical external appearance. Careful history, local examination and x-ray examination, however, revealed the origin of this process to be from a carious tooth, and, therefore, the area of incision was entirely different. The opening was made in the buccal fornix directly down to the bone, and about 1 c.c. of pus was evacuated. A light iodoform pack was put in for twenty-four hours, and there was rapid subsidence of all swelling and pain. Two offending teeth were removed without complications two weeks later when there was no sign of cellulitis present.

An important type of lip infection from a standpoint of diagnosis is the occasional one caused by a peridental infection about carious or nonvital maxillary anterior teeth. If a careful dental history is taken and local examination made, gross evidence of caries is usually found. X-ray pictures may show the bone involvement. The external picture may be identical with a true soft tissue infection, and this point is quite clearly shown in Fig. 2 *A* and *B*. The one patient (Fig. 2 *A*)

with a real lip infection finally needed an incision directly into the substance of the lip (from the inside), while the other (Fig. 2 *B*) needed an incision in the buccal fornix down through the periosteum and later removal of the involved teeth. These important points would be entirely missed if a correct diagnosis were not made.

Another origin of lip infections is from the cracking and crusting which occur around the floor of the nostrils during an acute cold or sinusitis in which pus is continually being discharged from the nose. This type of infection is most often a

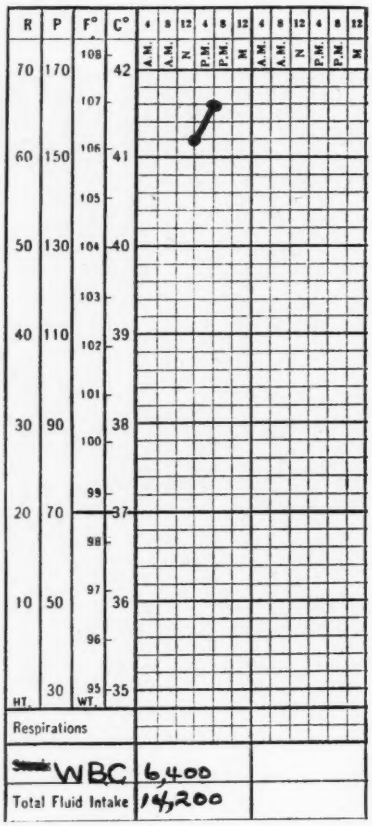


Fig. 3.—Temperature chart of a man forty years old who, just twenty-four hours before had squeezed a pimple on his upper lip. Following this, the small open area was treated by twisting an applicator soaked in carbolic acid around in the area. There was immediate widespread cellulitis and gangrene of the tissues, and, when the patient entered the hospital, he was in extremis with very high fever as shown in the chart, irrational, and his face was extremely distorted, swollen and discolored. No known therapy was thought beneficial for such an extreme infection, and the patient died ten hours later, about thirty-six hours after the onset of the infection. Autopsy not done.

spreading cellulitis of the nature of erysipelas and does not frequently form pus except in small superficial areas.

Infection and even necrosis of tissue may result from insect bites. In these there may be tremendous swelling that occurs rather suddenly, usually during sleep when the patient does not defend himself. There may be some difficulty in distinguishing these lesions from urticaria, but there is usually a history of previous attacks if the patient is subject to hives.

In the final summing up of the causes of severe infections, the patient's general

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condition should be thoroughly studied. Bad purulent infections any place in the body may accompany diabetes, and this possibility should always be checked. If there is uncontrollable spread with perhaps slough of tissue and bleeding, some more acute general disease should be suspected and a careful blood study made. Any one of the blood dyscrasias may be present or a general debilitation of some other type may be the cause of a lowered resistance that allows progress of the infection (Figs. 4 and 5).

Treatment.—When a pimple first appears, one of the simplest ways of caring for it is to apply a small piece of adhesive directly over it. Many times after twenty-four or forty-eight hours, when the patch is removed, the infection will be found

Fig. 4.—Boy of nine months, who had been having some diarrhea, developed a pimple on his chin. Two days later there were pus and fever, and the top of the pimple was lifted off. Following this procedure there was rapid spread of the infection.

On entry to the hospital there was a widespread, brawny infection of the whole lip and chin, and in spite of much active treatment there was a steady downhill course, with the development of gangrene as shown, followed by death.

Definite symptoms of a general debilitation are present in this case although the exact nature of it is not known. The baby had diarrhea, but, more important, a low white blood count of only 8,800. No other blood defect was found, but this low count compared to the high fever of 40° to 41° is evidence of a poor resistance.

to have localized, liquefied, and a tiny drop of pus may be present on the adhesive. The action of adhesive may be explained by (1) splinting the local part, (2) keeping the hands off and resisting the inclination to pick or squeeze the area, (3) conserving local heat, and (4) slightly macerating or softening the surfaces so that spontaneous discharge may be more easily effected.

For more widespread infections the same strict rule of not traumatizing them by squeezing or by inadequate surgical procedures applies, and there should be rest of the part by refraining from all possible talking and by taking soft foods. Hot wet packs for several hours a day and complete general rest are advisable. If there

is a draining area or the infection is one of the superficial types with cracking and crusting of the skin, it is highly important to keep the area softened at all times with a mild ointment.

X-ray treatment is indicated in most of these infections. If given soon enough, before pus formation occurs, it may bring about complete resolution without break-down of the tissues. If given after pus or slough formation has occurred, it may cause very rapid liquefaction and discharge of the slough two to eight days earlier than if natural separation were awaited. In many cases it may

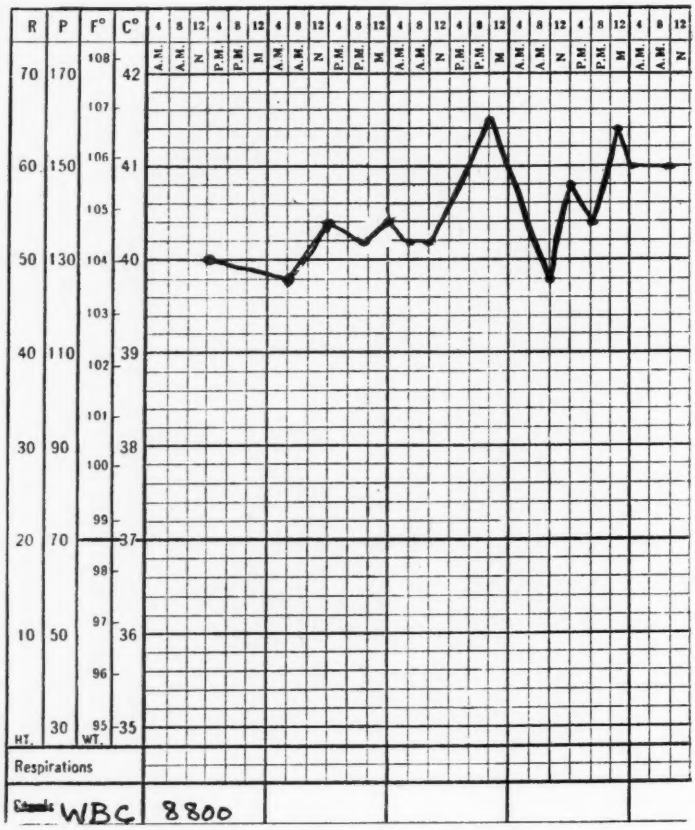

Fig. 5.—Temperature chart of patient shown in Fig. 4.

entirely supplant the necessity of surgical drainage (Fig. 1). An adequate dose is harmless as it is not necessary to give even an erythema exposure.

Operative Treatment.—Localization, encouraged by good general care, hot packs and x-ray therapy, is awaited for a reasonable length of time, and then a simple incision may be all that is necessary. Procedures such as picking the top off of an early pimple, twising an applicator with phenol in the center of the involvement, or doing any operating under local anesthesia should be entirely avoided.

In advanced cases radical surgery may be necessary, and, if there is persistence of a spreading infection with surrounding hard cellulitis, wide drainage with the cautery should be obtained. Cautery incisions are, of course, liable to be unsightly, and, if possible, they should be made on the inside of the lip (Fig. 2 *A*). Wide-

spread cautery destruction of the lip from the outside may be necessary at times as a life-saving procedure, and usually requires secondary repair of the damage.

Ligation of the angular vein has been advocated in cases of lip infection on the assumption that there may be a spreading phlebitis upwards, through the ophthalmic vein to the cavernous sinus with resultant meningitis. This procedure is not used in this clinic, because it does not seem possible to ligate all connecting vessels, the trauma of the operation itself appears distinctly contraindicated, and comparable death rates with and without the ligation are not convincing.

The drainage for dental infections is obtained by incision in the buccal fornix down through the periosteum, gently elevating it if necessary. A light iodoform pack is put in for twenty-four hours, and by this time a good draining cavity should be established. The offending teeth are never pulled during the acute stage of the infection but are removed two to four weeks later.

Prognosis.—The upper lip is a serious site for a spreading infection. Rest of the lip is difficult because both talking and eating cause movement. Drainage of the area is primarily toward the submaxillary lymph glands, but thrombosis of the angular vein is always possible in severe cases. Death occurs perhaps as often from general systemic infection as from meningitis, and Blair has made the statement that in every fatal case which he has observed there has been some early trauma to the area either by the patient himself or by ill-advised surgery.

Treatment on the whole should be conservative, but radical surgery is frequently necessary.

SYPHILIS, GEOGRAPHICAL TONGUE, AND HYPERTROPHIED PAPILLAE

(LESIONS OF THE ORAL CAVITY AND OF THE JAWS AND THE REGION OF THE JAWS, INCLUDING THE TEMPORAL FOSSA, ORBITAL CAVITY, AND SINUSES)*

JOSEPH COLT BLOODGOOD, M.D., BALTIMORE, MD.

(Continued from page 1114)

SYPHILIS

PRACTICALLY the same event has happened with syphilis of the mucous membrane of the mouth, including the tongue and lip, as has happened in syphilitic lesions of bone. The Wassermann reaction is so thoroughly standardized that the blood test suggests the possibility at once, and, still more important, the intravenous therapy, if the lesion in the mouth or bone *is syphilitic*, will so beneficially influence the local lesion that one may exclude cancer at once. Therefore, there is no objection and no danger in lesions of the oral cavity with positive Wassermann reaction in awaiting the effect of intravenous specific therapy. The danger lies in continuing the treatment with these patients whose blood Wassermann is positive when the local lesions show little or no beneficial effect. Previous to 1917 many patients with cancer of the oral cavity who came under the observation of the medical profession in the earliest operable and curable stage lost their lives because antiluetic treatment was persisted in too long.

AREAS OF IRRITATION

There are two types. In one, the patients are conscious of a sensitive area somewhere on the mucous membrane of the mouth, usually one, now and then two or more. They complain of a sharp stinging pain or a burning sensation. They claim that the area is sensitive to the touch. Yet, on inspection, nothing can be seen or felt. In this group there are more women than men, and in the majority of women tobacco in all forms is absent. In the men both tobacco and ragged, dirty teeth are present. In both, the Wassermann blood test has been negative. In practically every case there is fear of cancer. When you have the same sensations of pain and tenderness without the fear of cancer, with the rarest exceptions you can find on examination a definite local lesion. My records show that these patients complaining of areas of irritation in whose mouths on examination nothing can be found, have come under observation since 1920.

In the second group one can see a patch of mucous membrane, the area to which the patients refer the painful sensations, quite different in color from the

*One of a series of articles by Dr. Bloodgood that will appear in the JOURNAL over a period of eighteen months to two years. Originally published in *Lewis' Practice of Surgery*, W. F. Prior Company, Inc., and brought up to date.

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surrounding mucous membrane, as a rule more hyperemic, and, when on the tongue, as a rule smoother than in Fig. 38.

The most common cause of an area of irritation in those who do not use tobacco is Vincent's angina; the next is the fear of cancer. It is very common in smokers and probably due to burns from excessive smoking. These visible areas of irritation never suggest cancer nor even ulcer. To relieve them, one must find the cause in Vincent's angina, ill-fitting plates, irritation from teeth, pyorrhea, root abscess, infected tonsils, achylia, diabetes, or some faulty diet, a condition resembling scurvy. In addition, the element of fear must be relieved.

An Area of Irritation From the Pressure of a Plate Which Developed Into Cancer.—This is a unique observation. A woman came under my care almost two years ago with an extensive area of irritation from pressure from a plate. The area was on the left of the mandible and extended to the cheek. On palpation nothing could be felt; on inspection it was very red and sharply outlined

Fig. 38.—Pathol. No. 35866. Patient observed in 1924, well in 1932. Observe the smooth patch on the right side of the tongue present eight months in a male aged sixty-two years. No tobacco, Wassermann negative, Vincent's angina positive. This is an area of irritation.

from the surrounding mucous membrane. The area corresponded exactly to the portion of the plate which pressed on the right of the mandible. The plate was removed, but the patient continued to complain of pain, when after about nine months a very superficial ulcer appeared. This was excised at once with the cautery and found to be cancer. This is the first time in my entire experience that I have seen a cancer develop when after my first examination I could find no evidence of leucoplakia or ulcer or feel any induration, and when the cause of the area of irritation had been removed. This patient now, July, 1929, has a recurrence in the scar but no apparent involvement of the glands. It will be necessary to resect a piece of the mandible because x-ray treatment has failed to check the disease.

The lesson is that the moment plates give rise to discomfort and especially when they produce areas of irritation, they should be removed and corrected. Ill-fitting plates have produced more cancers of the mouth without the aid of tobacco than any other factor.

Every one who wears a plate should be instructed to clean the plate after each meal. This is best accomplished with a brush, hot water and soap. I be-

lieve that individuals who wear double plates should use a mild alkaline wash or gargle, a combination of liquor antisepticus and Dobell's solution. To some glycothymol solution is pleasanter, although more expensive.

Older people who have some pyorrhea, receding gums and who have or have not bridge work, must take greater care in cleaning the teeth. I found that perborate of soda used three times a week practically protects them against Vincent's angina. These individuals should also use a mild alkaline mouth wash two or three times a day.

Fig. 39.—Pathol. No. 35974. Diagnosed geographical tongue. Physician, aged thirty-six years; area observed many years. Photograph taken in 1924. No change in 1928. An accidental finding. Later the fear of cancer brought the patient under observation.

Fig. 40.—Pathol. No. 31488. Photograph taken in 1922. No change in 1928. Dentist, aged fifty years. Lesion present some months; piece has been excised for diagnosis. No etiologic factor demonstrated.

In one or two instances we have never relieved the area of irritation until we removed the buried tonsils, straightened the septum or drained a sinus.

To repeat, the element of fear and anxiety must be relieved.

GEOGRAPHICAL TONGUE

I find I have notes on about ten cases, the first of which was observed in 1914. The area resembles what we have described as an area of irritation except that it is paler than the surrounding mucous membrane. It gives the impression that the papillae had been clipped. On palpation there is no induration. There is rarely pain or any other discomfort. As a rule, the area is discovered accidentally when the patient, a doctor or dentist looks at the tongue. In two of our cases the areas had been observed fifteen to twenty years before I saw the patients. We have never found an etiologic factor. As a rule the area per-

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sists. The Wassermann reaction has always been negative, the majority of the patients have not used tobacco, and most of them had clean teeth. We have never observed it in the colored race, because, I am inclined to think, they do not pay attention to it. Figs. 39 and 40 illustrate the two types.

In the *Archives of Dermatology and Syphilology,* Lane reports,* with an illustration, a lesion resembling geographical tongue which he calls glossitis rhombica mediana, and he advises its removal with the diathermy needle.

I am quite sure that operation is not indicated on the geographical tongue, nor is biopsy.

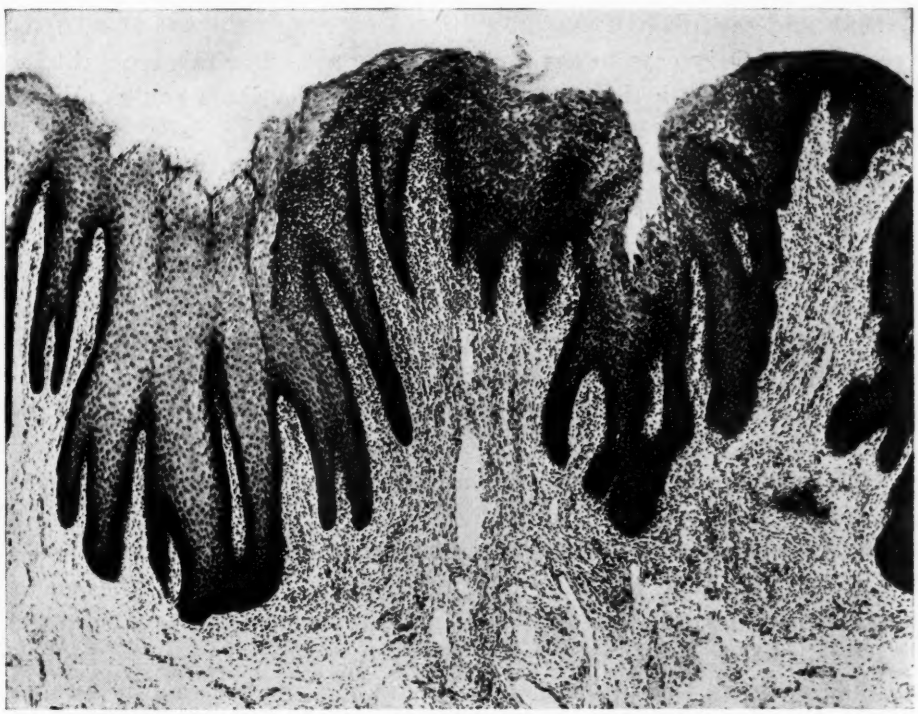

Fig. 41.—Pathol. No. 30138. Section excised for diagnosis in 1922. Patient well in 1932. Lesion present two years. No ulceration. The section shows hypertrophy of the papillae. No evidence of malignancy.

HYPERTROPHIED PAPILLAE

The size of the papillae at the base of the tongue varies even in the normal, and in some individuals, due to some form of irritation, the papillae may be very large. The average doctor or dentist seldom sees these lateral papillae at the base of the tongue near the anterior pillar of the fauces which often come in contact with the last molar teeth. To inspect this basal area of the tongue, one should pull the tongue out of the mouth with a piece of gauze, retract the cheek to one side and the tongue to the other and with a light examine these papillae. It is a good plan to become familiar with this concealed basal area of the tongue. When, from different causes, these papillae are irritated and the patient becomes conscious of this area, he may look at this part of the tongue and immediately fear cancer, or the doctor or dentist not trained in the inspection of this

*Arch. Dermat. & Syph. **9**: 557, 1924.

area may also fear a malignant lesion. I find I have records of thirty cases about equally divided between males and females. In the early years, between 1913 and 1917, the majority of patients came under observation after a piece had been excised for diagnosis. Now they are coming to our attention with a radium burn. Fortunately we have a number of cases which we have observed since 1914 and many more since 1920 who have had neither a piece excised nor an application of radium. All have been followed, and the patients have ultimately recovered without the development of cancer. Syphilis has not been a factor. There is not a single positive Wassermann reaction in either the male or the female group. In the majority of instances there have been irritations from rough and ragged, dirty molar teeth. In the men the use of tobacco has been recorded in every case, in the women usually not. For this reason it is suggested that teeth, rather than tobacco, are the predominate cause. Vincent's angina has been present in a few cases, as have infected tonsils. The fear of cancer was noted in practically all cases. As a rule, the papillae are just as large on the side that has given no sensation of discomfort as on the painful side.

The difficult thing is this: Cancer at the base of the tongue in the area of hypertrophied papillae is less common than in situations further forward on the edge of the tongue, but it does occur there. For this reason one must be able to distinguish hypertrophied papillae in which there is no indication for biopsy, excision with the cautery, or the application of radium from lesions in this region of the tongue that are distinctly precancerous. These lesions are leucoplakia, ulcer and wart, and have already been described. For hypertrophied papillae with complaint of irritation, the teeth should be thoroughly cleaned and smoothed. If Vincent's angina is present, perborate of soda should be used and there should be the usual routine and complete examination to exclude dental root abscesses, infected tonsils and sinuses. We have been unable to get a good photograph of this lesion, but if any one will pull out the tongue, retract the cheek and look at the base of the tongue, one can rapidly familiarize one's self with these papillae. Fig. 41 well shows the microscopic changes.

APPENDIX

There is very little to add from our experience. In the first place we rarely see a syphilitic lesion of the tongue, such as a mucous patch or a gumma or a diffuse glossitis, because all types of syphilis now are recognized so early, with a Wassermann plus, and come so quickly under treatment with intravenous therapy. We do occasionally see patients with tongue lesions, benign and malignant, with Wassermann plus reactions, but these lesions are rarely aided by intravenous therapy. It is therefore even more dangerous today than previously to make a diagnosis of a lesion of the tongue because the Wassermann reaction is plus.

Areas of irritation are on the increase. Where once we had cancer, we now have areas of irritation. They are becoming more common even than leucoplakia or Vincent's angina. To repeat: an area of irritation usually needs a complete diagnostic survey, during which time there should also be a routine therapeutic plan to relieve the irritation until its exact cause is discovered—stop tobacco,

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treat for Vincent's angina if present, clean the teeth, remove ill-fitting plates. Special search should be made in the region of the tonsils or the papillae of the tongue for concealed foci of infection. When my experience with lesions of the mouth began, the lesion I saw most was cancer, and in a man; today the lesion I see most is an area of irritation, in a woman.

Geographic tongue remains as rare as before, and our patients who have not died of old age are living, and the condition of the tongue has remained unchanged.

Hypertrophied papillae, like areas of irritation, are becoming more and more frequent, and less and less do we see an area of irritation treated with radium without biopsy or unnecessarily operated upon. The majority of oral surgeons and physicians are becoming familiar with areas of irritation at the base of the tongue.

(To be continued)

SURGICAL TREATMENT OF MANDIBULAR PROGNATHISM*

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ORTHODONTIC correction of mandibular prognathism has probably been one of the most disputed problems of orthodontia. Undoubtedly many brilliant successes have been accomplished by the use of the usual method of regulation of the teeth. In extreme cases of prognathism, however, surgical interference seems to be gaining more popularity. I believe it was Angle who, in 1898, made the following statement: "Several years ago the author became convinced that no operation dependent upon tooth movement alone could establish proper relation of the teeth or materially improve the facial lines in certain cases of pronounced overdevelopment of the mandible." Before this time Hullihen, in 1848, made a pioneer operation upon an elongated jaw with prognathism. Since then operations for shortening the mandible have been performed with increasing number by Blair, Ballin, Babcock, Pichler, Willett and many others. In general these operations have been accomplished by two methods.

The first method is to remove a section of the body of the mandible on each side, thus practically creating a double mandibular fracture and to immobilize the segments until union is complete (Blair, Ballin).

The second method is to cut the ramus on each side above the level of the mandibular canal, pushing the mandible back to the desired position and immobilizing it until healing is completed (Pichler, Babcock).

It is not my purpose to discuss the relative merits of these methods but to report a series of five cases that have been operated upon by me following the first method and to present my observation and conclusions upon them.

Four of the cases were similar, characterized by extreme protrusion of the mandible, while the fifth one had a pronounced open-bite. As the preoperative preparation, as well as the operations themselves, has been similar in all these cases, I shall give just a brief history of each case and then describe general methods of treatment.

CASE 1.—(E. S.) female, aged twenty-one years. (Fig. 1 *A* and *B*.) After the age of ten, the mandible gradually began to show abnormal protrusion until it assumed its present condition (Fig. 1 *C*). The family history was essentially negative. Examination showed a healthy young woman. The mandible was abnormally prominent; teeth were in good condition, but exhibited poor occlusion, especially on the right side. As a result, the median line had shifted to the right. An x-ray examination of the skull was negative, as was also the physical examination. The various measurements of the models showed displacements as follows: The space between the maxillary and mandibular centrals was 8 mm. anteroposteriorly, and the median line had shifted 14 mm. to the right.

On the basis of these measurements the sections of the mandible to be removed were calculated as follows: right side 5 mm.; left side 15 mm. (Fig. 2.)

*A paper presented to the Second International Orthodontic Congress, London, 1931.

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The right and left first molars were missing, but it was necessary to remove the right and left second premolars in order to provide sufficient space from which to remove the segments. Bands were then made in preparation for the splints and cemented before the operation onto the second and third molars and canines and first premolars on either side.

A *B* *C*

Fig. 1.—*A* and *B*, photographs of patient, *C*, showing position of teeth before operation, Case 1.

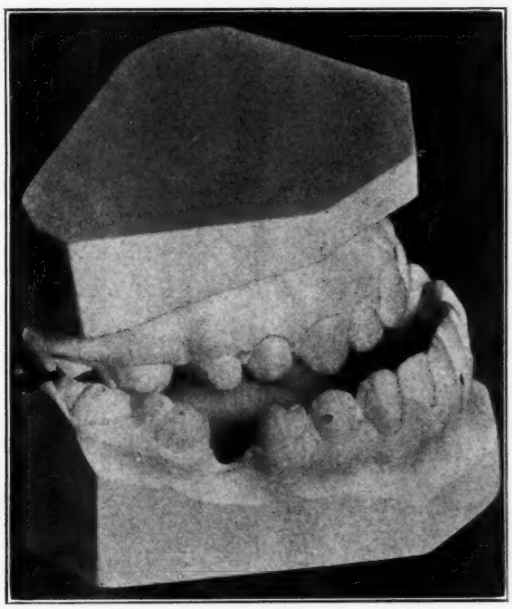

Fig. 2.—Models of teeth, Case 1.

Operation, July 14, 1931. Ether anesthesia was administered rectally. A small incision was made below the border of the mandible on each side. Through this opening the periosteum was separated from the mandible, and special clamps were fastened to the bone. With a Gigli saw, a section was removed from each side, the left hand section being larger than the right to harmonize with measurements made previously to the operation. (Fig. 3.) No special difficulty was encountered during the operation. The patient took the anesthesia well and re-

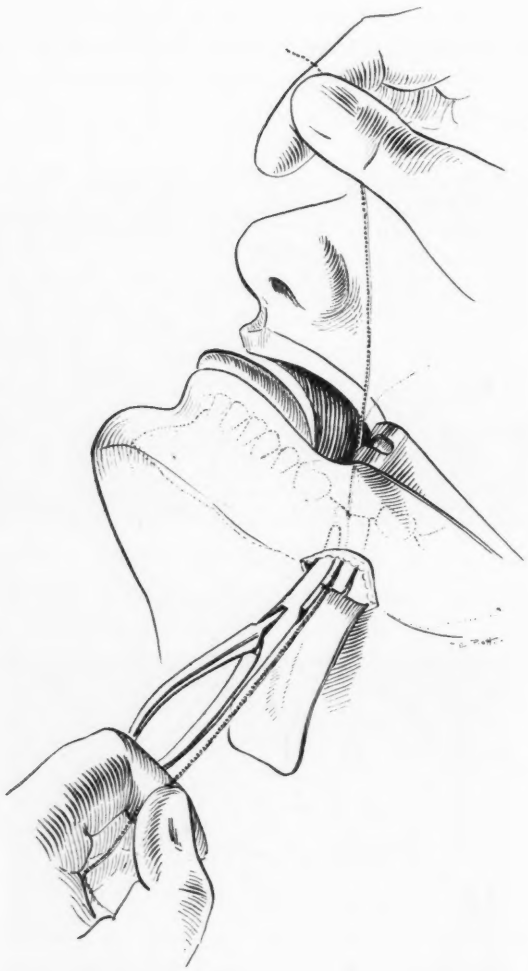

Fig. 3.—Diagram of operation: position of clamp; use of Gigli saw.

A *B*

Fig. 4.—*A*, result after operation. *B*, position of teeth after operation. (Case 1.)

mained in good condition throughout the operation. As soon as the sections were removed, the anterior fragment of the mandible was fastened to the distal parts by means of the splints previously prepared. A small rubber dam drain was inserted into the incisions to establish drainage. These drains were kept in until July 21. The patient had very little reaction. She was discharged from the hospital on July 27. The occlusion was good and the splints were holding well.

I saw the patient in my office once a week following her discharge from the hospital. On July 21, an x-ray picture was taken showing the jaw in good position. On August 22, the maxilla was freed from the mandible to allow more motion, the patient being able to use the mandible moderately well. On October 23, the splints were removed. There was complete consolidation of the mandible. (Fig. 4 *A* and *B*.)

CASE 2.—(L. B.) female, aged twenty years, (Fig. 5) was referred to me by the Orthodontic Department of the Harvard Dental School. She had noticed

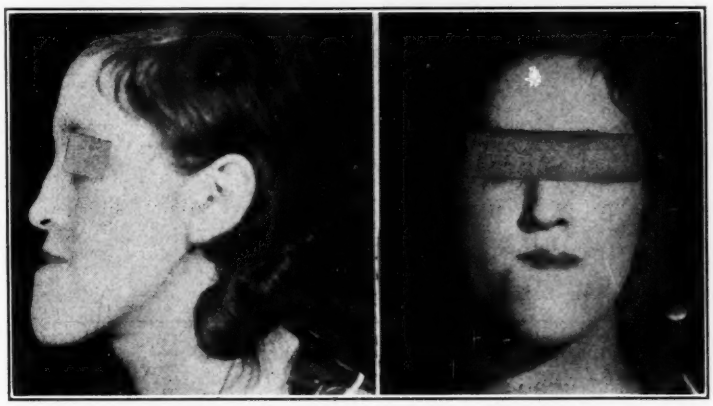

Fig. 5.—Photographs of patient, Case 2.

progressive enlargement of the mandible since the age of thirteen years. (Figs. 6 and 7.) Mastication was greatly impaired due to malalignment of the teeth. Her family history was negative except that her father was confined to a state hospital for the insane. The patient's past history did not reveal illness, soreness or injury. Her physical examination was essentially negative with the exception of low blood pressure which was 70/50. An x-ray examination of the head did not show any enlargement of the sella turcica.

Prior to the operation, measurements and other preparations were made from the study models. It was necessary to construct splints and cement them over the teeth as in the previous case (Fig. 8).

Operation, April 12, 1930. Rectal ether was used. The same operative procedure as in the preceding case was followed. Small incisions were made on each side of the jaw and a section of bone was removed with a Gigli saw. Each section measured approximately 11 mm. in length. In addition to the dental splints used in this case to hold the jaw in position, wire sutures were used along the lower border of the mandible. This, I believe, later proved unnecessary and somewhat complicated the recovery.

Fig. 6.—X-ray picture showing splints in position, Case 2.

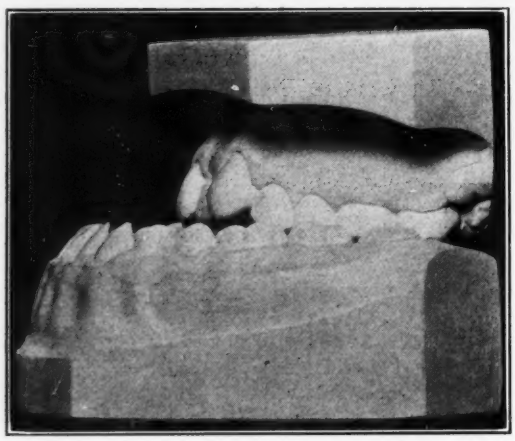

Fig. 7.—Models of teeth before operation, Case 2.

The patient had very little postoperative reaction and was discharged from the hospital on May 5, with instructions to report to the Outpatient Department for follow-up treatment. She was given permission to return to her work in New York.

When she reported a few months later, there was a complete consolidation

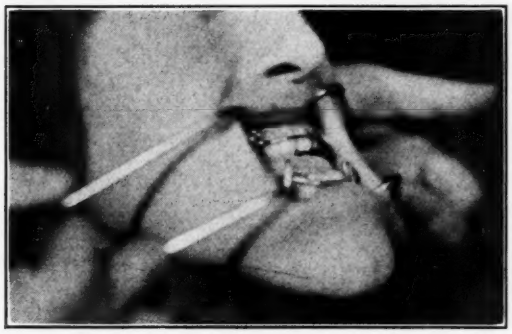

Fig. 8.—Patient with splints in position, Case 2.

Fig. 9.—Photographs of patient on discharge from hospital, Case 2.

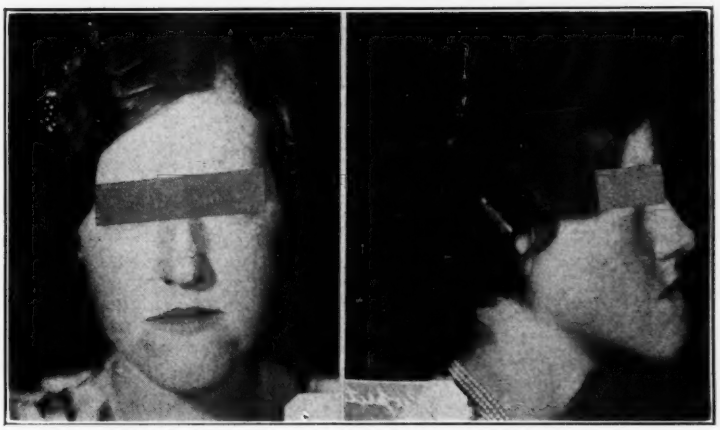

Fig. 10.—Patient before operation, Case 3.

of the mandible, facial appearance was greatly improved, and the occlusion of the teeth was fair. The anesthesia of the lower lip which was caused by the resection of the mandibular nerves had disappeared. (Fig. 9.)

Case 3.—(K. B.) female, aged sixteen years. (Fig. 10.) This patient had also observed a gradual protrusion of the mandible since the age of ten years. The personal and family history was negative, except that her father had a

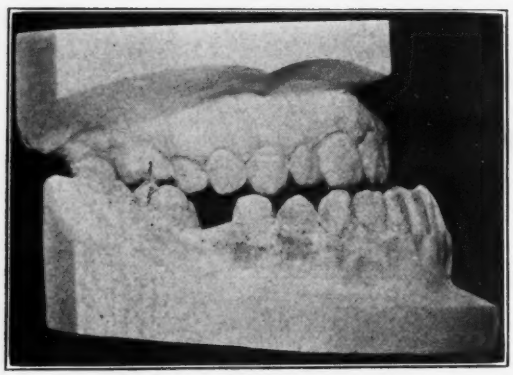

Fig. 11.

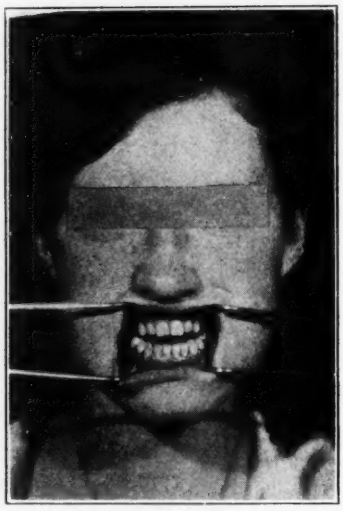

Fig. 12.

Fig. 11.—Models showing position of teeth before operation, Case 3.
Fig. 12.—Showing teeth before operation, Case 3.

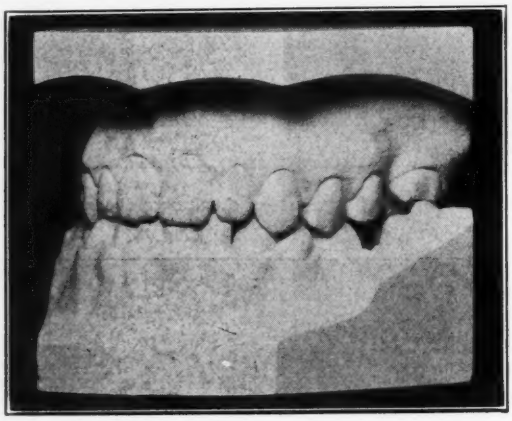

Fig. 13.—Models showing position of teeth after operation, Case 3.

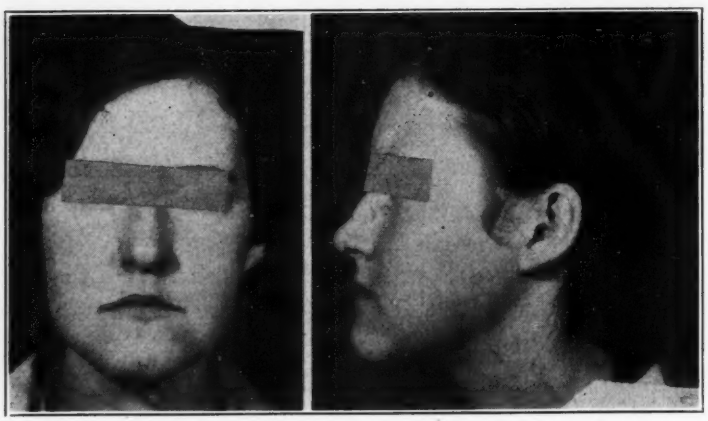

Fig. 14.—Patient after operation, Case 3.

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prominent mandible, although not so marked as that of the daughter. Physical examination as well as x-ray, etc., was negative. Local examination showed abnormal prominence of the mandible; so much so, in fact, that there was very little contact between the maxillary and mandibular teeth. The measurements of the models showed the following displacements: The space between the maxillary and mandibular centrals was 6 mm. anteroposteriorly, while the median line was distorted 2 mm. to the right. The right mandibular first molar and the left second molar were missing. (Figs. 11 and 12.) Previous to the operation, the

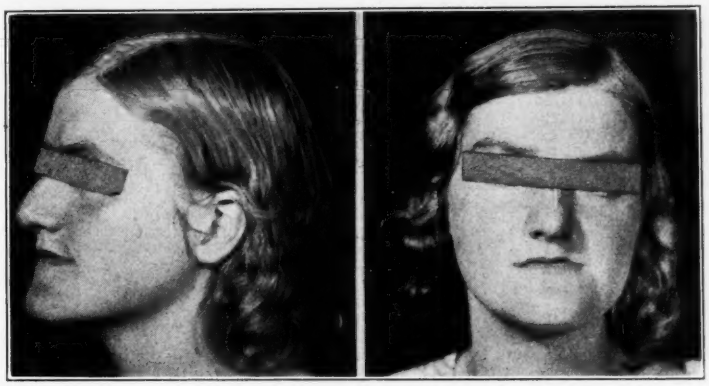

Fig. 15.—Patient before operation, Case 4.

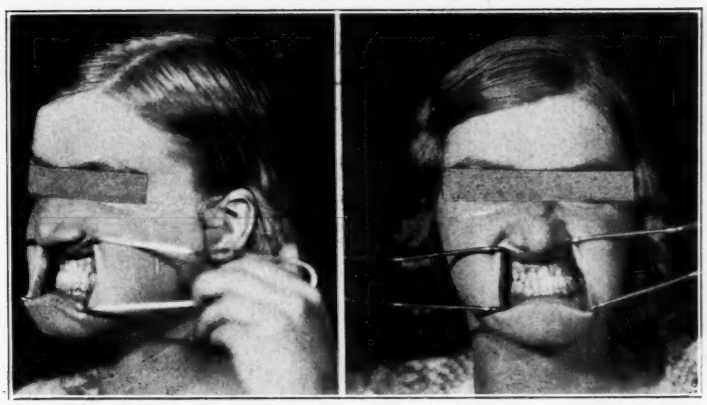

Fig. 16.—Showing position of teeth, Case 4.

right second and left first molars were removed, and appliances were constructed and cemented onto the teeth for the same reason as before.

Operation, July 9, 1930. Rectal ether was used. The same procedure was followed as in the previous cases with the exception that drainage was not established. It was necessary, however, to open the wound later to allow disorganized blood to drain out, thus making the patient more comfortable. X-ray pictures taken on July 21 showed the fragments in good position. She was discharged from the hospital on July 26. On October 4, the splints were removed. The patient was finally discharged on November 29. There was complete consolidation of the fragments. (Figs. 13 and 14.)

Case 4.—(M. D.) female, aged nineteen years. (Fig. 15.) This patient has had a deformity of the mandible all her life. It has caused no discomfort

with the exception of difficulty in chewing. She gives a history of a fall from a swing at the age of eight years. Her brother has a similar condition of the jaw, but it was corrected by orthodontia. She had consulted a well known orthodontist who did not consider her case suitable for regulating. Family and personal history was negative. Examination showed considerable prominence of the chin and poor occlusion of the teeth (Fig. 16). Previous to the operation, the mandibular first molars on each side of the jaw were removed by her dentist, and the sockets were well healed before she was admitted to the hospital. As in the previous cases, the splints were constructed and cemented over the teeth before the operation.

Operation, June 12, 1931. Rectal ether was used. The same procedure was followed in this operation as in the others.

This patient is still under treatment. X-ray pictures taken on June 25 showed the fragments in good position with a callus formation on the left, while

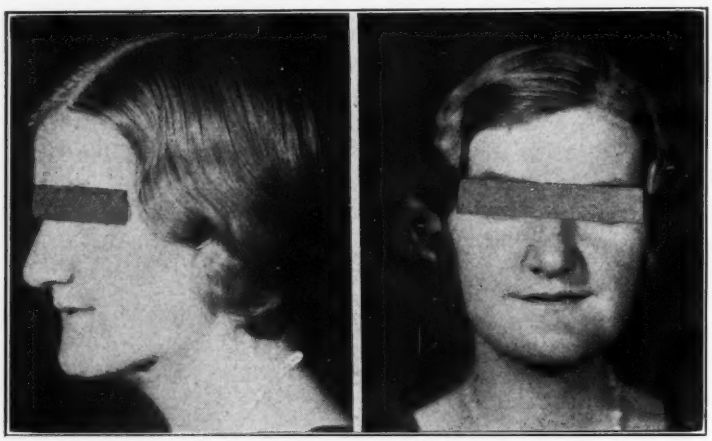

Fig. 17.—Patient after operation, Case 4.

on the right the contact of the bone was not as good, there being a V-shaped space on the lower border. (Fig. 17.)

Case 5.—(P.) male, aged sixteen years. This case was a patient with an abnormal open-bite (Fig. 18). His chief complaint was an inability to masticate or to speak distinctly; he had been obliged to take speech lessons in order to be understood. He was also sensitive of the facial deformity.

The family history was essentially negative, with no traces of tuberculosis, cancer, or malformations. With the exception of an illness at the age of two years which the patient thinks caused the "open mouth," his own history was negative. As in the previous cases a complete physical examination showed negative findings. Repeated questioning failed to reveal any habits of thumb sucking or tongue biting. There was no history of stomach troubles as a result of poor mastication, no soreness or pain in the jaws at any time, and no history of injury to the jaw. Local examination showed an extreme open-bite with prominent mandible. The space between maxillary and mandibular teeth was 11 mm., and the only point of intermaxillary contact was between the last molars. The tongue was abnormally large. Speech was poor, being more or less throaty.

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Mouth hygiene was poor. Close examination of the mouth revealed the fact that the condition was due to deformities of both the maxilla and the mandible, and the alveolar processes were abnormally high. For obvious reasons it was de-

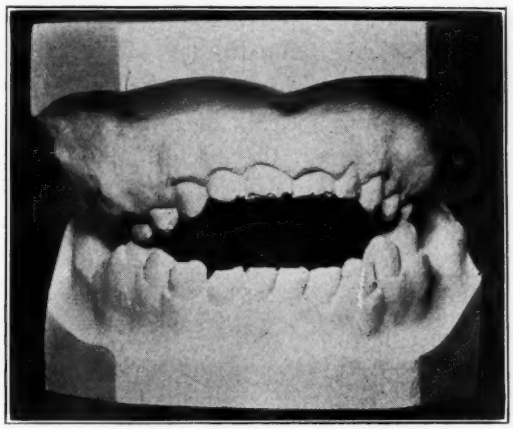

Fig. 18.—Models of teeth, Case 5.

Fig. 19.—Diagram of operation, using surgical burr for cutting the mandible, Case 5.

cided to cut through the mandible at the molar region on each side and elevate the anterior segment to meet the maxillary teeth.

Previous to the operation the first molars on each side of the mandible were

removed, teeth were put in good condition, splints constructed and cemented into position. This preliminary work was done at the Harvard Dental School.

Operation, February 10, 1931. Rectal ether was used. The usual incisions were made along the lower border of the mandible, and the body of the bone was exposed. A semicircular incision was attempted. On the right side a special semicircular trephine was used, while on the left side the cutting was done with a surgical burr. (Fig. 19.) The trephine cutting was rather disappointing and the result not what I anticipated, but the surgical burr seemed to work very satisfactorily. After cutting through the mandible, the jaws were immobilized by wiring the maxillary and mandibular teeth together in the best possible position.

Fig. 20.—Showing position of teeth after operation, Case 5.

The patient made an uneventful recovery and was discharged from the hospital on March 3 with instructions to return to the Outpatient Department for follow-up treatment. The teeth were in fair alignment (Fig. 20).

On February 25 the x-ray picture showed that the left side of the mandible had already consolidated, but the union on the right side was delayed, due to the involvement of the right molar tooth which was in the line of fracture. This tooth was removed immediately and union obtained.

As all the cases received approximately the same treatment, I shall describe the general method of procedure with occasional emphasis on variations in technic.

PRELIMINARY DIAGNOSIS AND PROGNOSIS

On the study models the exact location of the operation was determined as about the mandibular first molar region. Two of the cases (2 and 3) had no molars, while in Cases 1 and 4 the first molars were sacrificed. The measurements determining the exact size of the piece of bone to be removed were also made on the models. The following method of measuring was adopted. Study models were placed in the existing condition and marked with perpendicular lines over the last molar region. Then the maxillary models were carried forward

to assume the position which would result in the most satisfactory occlusion. The marking of the maxillary model was extended down to the mandibular model, and the distance between the first and second lines on the mandibular model determined the amount of bone to be removed on each side. Owing to the deviation of the median line, these measurements on the right and left sides differed in all cases. (Fig. 21.)

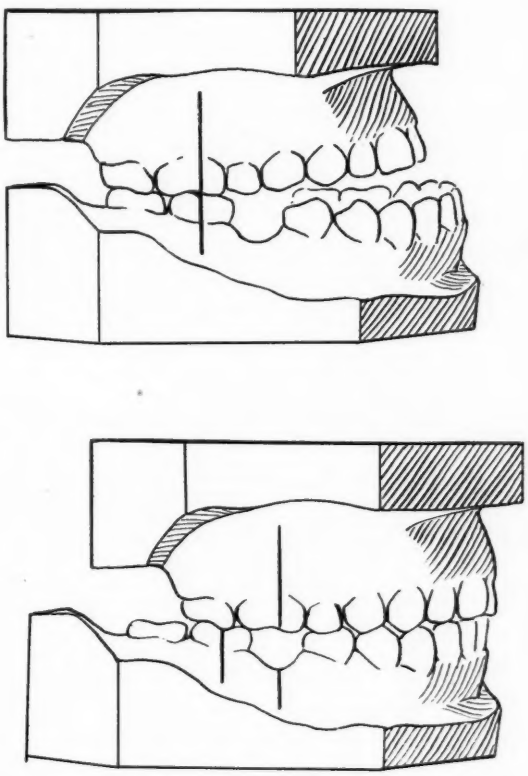

Fig. 21.—Diagram showing method of measuring the size of section of bone to be removed.

OPERATIVE PREPARATION

In addition to the preliminary work with models, described above, we had to remove specific mandibular teeth at least a month before operation. If this step is left until a later date, the healing process will undoubtedly be considerably delayed. The next step is to construct splints. In all cases approximately the same type of splint was used. Realizing the fact that it would not be possible to remove a section of bone with absolute accuracy as to measurement, I attempted to make splints in an adjustable form so as to allow for effective immobilization of the parts.

The splints in the diagram (Fig. 22) are (*A*) a retention splint fastened to the maxillary teeth and (*B*) a mandibular splint in three sections.

Bands were fitted over the posterior teeth and a round tube was soldered to the buccal surface. At least two anterior teeth were utilized on each side and then fastened together with a stout wire. A vertical slot was soldered into the buccal side of these bands. After the operation the anterior and posterior bands

were connected with a stout wire threaded on one end and hooked on the other. The advantage of this procedure is that it allows for a readjustment to new positions as healing of the parts progresses.

OPERATIVE TECHNIC

In all cases colonic ether was given, and it proved to be very satisfactory inasmuch as it gave the surgeon free access of the operative field. An incision

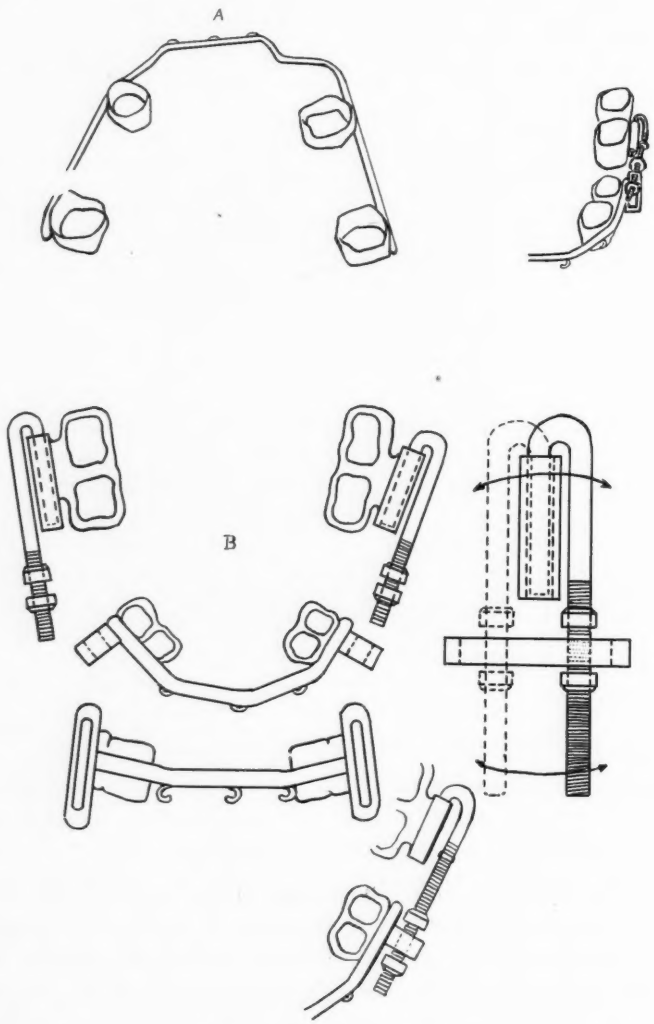

Fig. 22.—Diagram of splint.

about 1 inch long was made along the lower borders of the mandible. The bone was exposed and separated from its periosteum on the buccal as well as on the lingual side. The operative exposure was extended to the buccal cavity, and sectioning of the bone was made with a Gigli saw. In order to have good control of the direction of the saw, a curved serrated hemostat, bent approximately to the contour of the mandible, was clamped to the bone and the Gigli saw was introduced distally to the clamp. As one line was cut, the clamp was shifted forward according to the measurements and the sectioning was repeated (Fig. 23).

In all the cases there was no troublesome hemorrhage from mandibular vessels.

As soon as the sectioning was completed, the hooked wire was introduced and the parts were fastened together. In addition intermaxillary elastics were applied to the maxillary and mandibular splints. In the first case wire suturing was done at the lower border of the mandible, but in subsequent cases this practice was discarded as it seemed unnecessary and undoubtedly caused irritation.

POSTOPERATIVE CONVALESCENCE

Temperature charts indicated slight elevation of temperature in the first two days, not over 100 degrees. There was a slight postoperative swelling or edema. External drainage was necessary in all the cases for a time. After the second week the mandibular splint was sufficient to hold the parts in position effectively, so that the interdental elastics were discarded, and the patients were able to use the mandible quite effectively. There was naturally complete anes-

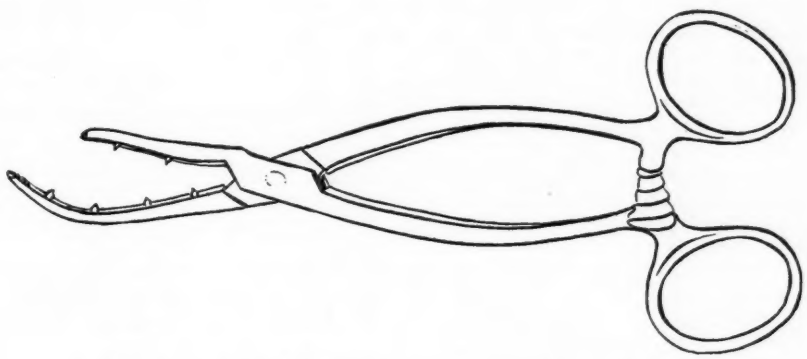

Fig. 23.—Special clamp used to act as a guide to Gigli saw.

thesia of the lower lip from the beginning, but this was a temporary condition and within six months the first three cases were perfectly normal. Union was complete in all these cases when last examined—Case 4 is still under treatment (July, 1931), the operation being on June 12, 1931.

In all cases there was a marked improvement in facial appearance. The occlusion of the teeth was fair in the first and third cases, and excellent in the second and fourth.

During the healing of the bone, it was necessary from time to time to make adjustment of the splint in order to improve the occlusion of the teeth. Not infrequently I was obliged to push the mandibular molars medially in order to improve the alignment. This was done simply by rotating the connecting wires slightly outward. In the meantime a vertical slot fastened to the mandibular premolars allowed plenty of room to effect this adjustment. In the same manner a backward swing of the anterior section of the mandible was resorted to at times by changing the position of the screws holding the slotted wire firmly in position. For this purpose I found the splints used in my cases superior to unattachable types.

One of the arguments advanced against this type of operation is that sound teeth are sacrificed. This, of course, is apparent, leaving aside the fact that the

majority of the patients in my care had previously lost some molars. If, instead of sectioning the bone, the entire ramus was pushed backward by cutting through it, the mandibular third molars would undoubtedly be useless. Another argument presented is that the exposure of the oral cavity invites infection. Judging from the foregoing cases, as well as from clinical observation of compound fractures, we need not consider this possibility as a contraindicant. In order to consider the relative value, however, of these different operative procedures, it is necessary to collect data on many more cases than I have presented here. One thing certain is that surgical treatment of selected cases of malocclusion, usually involving extensive deformities, has a definite place in the scientific approach of the orthodontist to the whole problem with which he is confronted.

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DISCUSSION

Mr. Badcock wished to know whether acromegaly was the cause of the enlarged jaw in any of Dr. Kazanjian's cases. He also wished to know whether he controlled the posterior segments in cases where there were no molar teeth.

Dr. Singer asked whether Dr. Kazanjian had observed cases of mandibular resection where there had been an absence of sensory nerve regeneration in the anterior part of the mandible, following operation.

Mr. Cale-Matthews after congratulating Dr. Kazanjian on the wonderful results he had obtained, pointed out that the operation was practically unknown in this country for the correction of mandibular prominence. He said that while he was at King's College Hospital he had a patient on whom Mr. Wakeley performed this operation with complete success. In this particular case the prognathism was not of very great importance because the patient was an epileptic and a mental deficient, but the deformity was so extraordinary that even in her case there might have been a possibility of the inferiority complex being improved.

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Mr. Pitts said it seems very evident that when we take these cases and the long series of cases recorded by Dufourmental of Paris, the surgical treatment of prognathism has got beyond the experimental stage. It is only within the last decade that the surgeon has obtained such a degree of control over the rather refractory substance on which he works as to justify such cases. He imagined that the number of cases suitable for an operation of this kind would always be limited, but severe cases of prognathism were so very distressing to the individual that he could not help feeling that we should hear very much more of this operation in the future.

He would like to ask Dr. Kazanjian whether he had contemplated or tested the procedure of elongating the jaw in cases of mandibular retrusion. From time to time one saw cases of so severe a degree that the deformity was hideous in the extreme, now that the procedure of bone grafting had become an assured operation and a method of treatment became feasible.

Dr. Kazanjian, in reply to Mr. Badcock's question, said there was exclusion of any kind of acromegaly in his patients who were all young adults. We know that acromegaly shows protrusion of the mandible and also brings about changes in the skull as well as in the hands and so on. If such cases came to us, it would be unwise to operate because we cannot control further changes in the jaw.

If the teeth are absent in the back of the jaw he did not see any contraindications for wiring the segment of the bone together and eventually removing the wires.

The absence of regeneration of the sensory nerve was possible. He could not remember any of his cases who had developed permanent absence of sensation of the lower lip, but in any case he had not heard any complaint even from absence of sensations. Patients usually got reconciled to it and forgot that they had a numb lip.

Operations for mandibular retrusion were very successful and he had three cases in the exhibition room showing elongation of the mandible by surgical means. The cases he operated on were done, not by bone grafts, but by making a complete incision along the mandible and elongating it. However, bone grafts in some cases were very successful.

ABSTRACTS OF
CURRENT LITERATURE

NUTRITION AND PEDIATRICS

By Samuel Adams Cohen, M.D., New York City

It is the purpose of this Journal to review so far as possible the most important literature as it appears in English and foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Educational Achievement of Delinquent Boys. Vera A. Chase. J. Juvenile Res. **16**:3, 1932.

The timely question: how does the total educational achievements of a group of delinquent boys compare with the total educational achievement of other children as measured by the norms of the new Stanford Achievement Test was considered by the author. (The new Stanford Achievement Test gives information regarding three aspects of the individual's reading ability, two aspects of his arithmetic ability, and of the following subjects: language usage, literature, history, civics, geography, physiology and hygiene.)

This important and interesting study prepared under the direction of Dr. Norman Fenton, University of Southern California, was made on delinquent boys between the ages of eight and sixteen years who were committed to the Whittier State School, California. Among the important findings of these individuals as compared with norms were: (1) in reading the achievement of the delinquent boys was just barely average; (2) the least efficient learning of the group of delinquent boys was in arithmetic fundamentals, and this investigator holds that their low efficiency is suggestive of the curriculum needs of the boys; (3) in physiology, dictation (spelling), language usage, history and civics the delinquents were comparatively low in achievement; (4) geography was the subject in which the delinquent boys had made the most progress towards normalcy. In this respect the author mentions that possibly this was a source of interest to them and suggests a usefulness in motivating interests in other subject matter.

The Significance of Phosphorus and the Ca:P Ratio in Caries Susceptibility and Immunity in Experimental Animals. Henry Klein and E. V. McCollum. J. D. Res. **12**: 3, 1932.

In their discussion of the existing data concerning the relationship of diet to dental caries susceptibility and immunity, Klein and McCollum make the pertinent observation that many of the investigations aimed at the production of dental caries experimentally have resulted only in defective calcification. Moreover, they point out that a close relationship has been erroneously postulated to exist between the two disorders—dental caries and defective calcification. From the standpoint of definition they also point out that these two conditions possess

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little in common and moreover, from the standpoint of pathology, these two end-results bear no resemblance. They further state that while the recurrent inference of food having a bearing upon dental caries does not seem extraordinary, nevertheless they remark that the exact dietary factors responsible for the reported dental caries are as yet unrevealed.

In their reanalysis of Howe's intensive labors on the effects of scorbutic diets upon the production of dental caries in monkeys, Klein and McCollum conclude that his findings indicate that a vitamin C deficiency can exist in the absence of gross dental caries, and also that factors (low calcium, high phosphorus) tending to produce defectively calcified teeth do not cause dental caries in monkeys.

In analyzing some of the experimentation on dogs by May Mellamby, these authors also noted that many of the diets given to them were low in calcium and high in phosphorus. As a result the teeth of these dogs tested were poorly calcified, but there was no dental caries. As a result of investigation of their own the authors found that similar results were obtained on swine.

On the other hand when Klein and McCollum used rats as experimental animals they found that with a diet high in calcium and low in phosphorus dental caries developed in 88 per cent of the group. From these data the authors are of the opinion that dental caries susceptibility is associated in experimental animals with a diet in which the phosphorus content is low and that caries immunity is related to a diet containing a high percentage of phosphorus and a low one of calcium. Along the same line of thought they feel that little correlation has been shown between defectively calcified teeth and caries susceptible teeth.

From their own experimentation and analysis pertaining to Hoppert's interesting work on the relationship of the size of food particles to dental caries susceptibility, they state that speaking generally it is possible that impaction of food particles may play a rôle in caries susceptibility in rats. They claim that this view is strengthened by histologic evidence (as yet unpublished) which indicates that food impaction does play a rôle.

In support of their views the authors, who write from the School of Hygiene and Public Health, Johns Hopkins University, Baltimore, noted that the available data indicate that the phosphorus level in the diet and possibly in the blood and saliva (indices of phosphorus utilization) is related to dental caries susceptibility and immunity and that the ingestion of diets low in phosphorus seems to favor caries susceptibility.

In summarizing, Klein and McCollum state that while evidence is as yet far from convincing that phosphorus levels are the *controlling* (italics authors') factors in caries immunity and susceptibility, nevertheless they believe that the above data direct attention to (1) the possible rôles that phosphorus may play in such phenomena; (2) the indication that there is little correlation between structural excellence and immunity to dental caries, or between structural dental deficiencies and susceptibility to dental caries; (3) the apparent lack of relationship between vitamin C deficiency and susceptibility to dental caries; and (4) the indication that adequate diets do not apparently afford protection to monkeys or rats against dental caries.

The Duration of Isolation in Scarlet Fever. J. Schreiber. La Clinique, Paris, **5**: 27, 1932.

By means of a questionnaire Schreiber ascertained the views of twenty-three European authorities on the duration of isolation for scarlet fever. He was particularly interested to learn their opinions whether forty day isolation period for scarlet fever was justifiable (1) from the prophylactic standpoint to prevent the spread of the disease and (2) from the interest of the patient himself.

The minimum isolation period—recommended by only one of these physicians—was twenty-one days, and this physician limited this duration of the quarantine to only mild cases of scarlet fever. About one-third of the physicians thought that a minimum isolation of forty days was justifiable in all cases of scarlet fever. Schreiber states that there is a general agreement among all the authorities that every case of scarlet fever showing such complications as coryza or otitis should be prolonged beyond the forty day period.

Asymmetrical Dental Stigmata in Congenital Syphilis. G. R. Stathers and R. M. Skidmore. J. D. Res. **12**: 3, 1932.

These authors studied 105 cases of congenital syphilis from the Wills Eye Hospital, Philadelphia. All these patients, whose ages range from four to forty years, showed interstitial keratitis. In addition, in this series there were 4 cases of deafness and 16, or 15+ per cent, showed unmistakable Hutchinsonian teeth.

In regard to the teeth the authors, who write from the School of Dentistry, University of Pennsylvania, Philadelphia, noted that in 7 of the 16 cases the Hutchinsonian dental stigmata were asymmetrical. Moreover, they confirmed the observation of others in observing that there were cases of Hutchinson incisors without affected molars and also cases of mulberry molars without affected first and second incisors.

In their comments Stathers and Skidmore state that two points of interest stand out: (1) In cases of congenital syphilis the full Hutchinson triad [sudden deafness—interstitial keratitis—Hutchinson incisors] is rare. (2) "The relative frequency of asymmetric distributions of the dental stigmata calls into serious question some of the theories on the etiology of these stigmata."

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EDITORIAL

Very Rapid Orthodontic Treatment

YEAR by year more propaganda is circulating among the laymen that it is quite possible and practicable to treat cases of malocclusion successfully and with dispatch within only a few weeks or several months. It is said that a retainer may then be supplied for a few weeks or a month, and then dispensed with; and it is explained that inasmuch as the teeth have been moved physiologically, it is unnecessary to use further mechanical retention. The impression is made upon the lay mind that the orthodontist who makes no claims to supply this extraordinarily high speed treatment in 1932 either is hopelessly antiquated in his methods and technic or deliberately draws out the treatment indefinitely for pur-

poses best known to himself. Of course the orthodontist who does not make any claims for unusually rapid treatment is not in accord with either of these impressions, which manifestly reflect upon his ability. However, until now he has paid very little attention to such claims, because he has, unfortunately, observed relapses of orthodontic cases treated by every known method, including in many instances the type of so-called physiologic tooth movement, and he knows that there has been no secret formula discovered that is not well known to the average orthodontist of experience.

Probably the activating inspiration for so much effort having been made in the interest of so-called rapid treatment is the enormous amount of dillydallying with orthodontic cases which has been done in the past, for in many instances treatment of cases has extended over a long period of time, sometimes years. This has, no doubt, done the specialty a great deal of harm; for cases must be treated intelligently, consistently and thoroughly; the teeth must be placed in normal function with a reasonable degree of promptness if the natural forces of growth and development are to operate advantageously to the patient.

Stories concerning an unusual idea gain momentum in direct proportion to the number of times they are repeated, and they attract the attention of THE INTERNATIONAL JOURNAL OF ORTHODONTIA, ORAL SURGERY AND RADIOGRAPHY, inasmuch as this JOURNAL serves its subscribers and readers who are eager for orthodontic information and who are located in every civilized country. The JOURNAL publishes manuscripts of authors from many of these countries, and up to this time no material or manuscript has ever come under the scrutiny of its editorial staff which makes any such claims of efficacy and dispatch of treatment and rapidity of action as are being indiscriminately broadcast among the laymen at present. The seed apparently is being sown from sources which, if entirely sincere, are at least overzealous and perhaps oversold as to their own exceptional ability. The main trouble seems to be that enthusiasm over rapid treatment, especially among inexperienced men, is responsible for grossly exaggerated reports which, after being told a few times, become first increasingly exaggerated, then ridiculous. It is no new psychologic fact that an individual may develop such a burst of enthusiasm over an idea that he can, step by step, sell himself a scientific hypothesis which is only partially true, then by pondering over the hypothesis long enough and telling his story frequently enough actually believe it himself.

It is difficult for patients to reconcile themselves to a situation in which one practitioner in whom they have confidence explains that the probable duration of time which may be involved in successful correction of their case may be one or two years, and at the same time another operator in another locality will indicate that the duration of treatment under his very excellent care will be only two or three months' time. There is plainly something wrong in these conflicting opinions.

For the most part, stories of speedy treatment (that of the spectacular kind) and of the ensuing results are not new. In fact the majority of orthodontists have heard informal tales for a number of years, and they listen to stories of voodoo treatment complacently, with an attitude, more or less, of "important if true."

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A story is told about a golfer who was generally known to be in the mediocre class of players and who came in one day with a score of 72 strokes for 18 holes. With great enthusiasm, gusto and pride he told his colleagues in the locker room of the wonderful achievement. His friends, being somewhat astonished, set about checking this low score, and upon calling in his caddy of the day received the information that the golfer had inadvertently lost his pencil after playing 9 holes, and for this reason had been unable to count the strokes of the last 9 holes. Judging from current comment, orthodontists believe that in the hearsay regarding two- and three-month correction cases, someone has lost his pencil in figuring the actual time involved and has, possibly inadvertently, "failed to count all of the strokes."

It should be remembered that all cases do not fall within the same category but offer a wide variability in the individual problems which are involved. For instance, the length of time required for treatment in any group of cases will vary, sometimes in a marked degree, and this has been found to be true even among children in the same family. Time is dependent also upon several factors entirely unrelated to appliances: the age of the child, the sequence of eruption of the teeth which must be in place before active treatment measures can be entirely discontinued, the growth and development of deficient muscles and osseous structures. There is also the very important factor of intermittent osseous growth in childhood, as brought out in Howard's work at the Good Samaritan Clinic in Atlanta. He clearly establishes the fact that a child may be much more satisfactorily treated one year than the previous or the subsequent year, or vice versa, depending largely upon the growth spurts characteristic of childhood.

A case of malocclusion is usually believed to be corrected successfully after highly active treatment has been accomplished, the occlusion allowed to adjust and fix itself definitely to place in the process of mastication, and a period of retention observed, checked and double-checked until such time as there is no relapse. The duration of treatment for complete correction is usually estimated from the time the case is started until such time as a final check for relapse has been concluded. The actual time estimate of duration of treatment in cases is highly flexible, depending largely upon the type of yardstick chosen by the individual operator.

In checking over the published records elsewhere of the case reports of what are ostensibly supposed to be rapid treatment cases, it is found that if the time consumed in the first period of treatment is added to that of the second period of treatment, etc., the time consumed is no less than that consumed by thousands of other treated cases in which no particular claims for rapid treatment are made.

However, more wonderful things have happened authentically in the annals of scientific advancement than the proposed correction of average cases of malocclusion within two or three months' time. It is our contention that the proof of the ultimate efficacy of this type of treatment should really be easy to establish if it is important. If there are operators who sincerely lay claim to the distinction of great success in this treatment (and by their own statements, there are), the proper, logical and most appreciative audience available is the orthodontic societies of the world. If one man or group of orthodontists is able consistently and successfully to correct malocclusion in two or three months, and to retain it

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without ifs and ands and buts, these operators should not boast and brag and ridicule but should prove the treatment to the world in no uncertain terms, in the interest of the science. This is customary in science, particularly in relation to human ills. To paraphrase a well known proverb, the orthodontic world as well as the public will soon make a beaten path to the door of those who can accomplish these results; furthermore, such men will undoubtedly go down in orthodontic history as having made the greatest single contribution to the work in its entire history up to now.

Until such time as proof is formally made without qualifying reservations or restrictions, this "gilding of the lily" to the laymen will be discounted by the majority of the orthodontists of the world as purely professional promotion and sales propaganda. Orthodontists at present are receiving the spectacular rapid treatment idea with a knowing wink and with the mental reservation that probably, on account of unbridled enthusiasm often coupled with unseasoned experience, the ardent advocates of this spectacular method have allowed their enthusiasm to carry them into the chaos of the clouds of reason. Such extremes can be made just as great a disadvantage to the advancement of orthodontia as can the so-called errors and mistakes of dillydallying with cases for an indefinite period of time, such as has obviously been done by some workers in the past.

Better cooperation among the members of the profession should result in greater harmony of thought, so that it would be impossible in the future for the ridiculous "believe it or not" conflicts of opinion to exist in orthodontics.

No doubt some good has been accomplished as a result of the rapid treatment propaganda because it has focused attention upon the dillydallying methods of some practitioners of the past and will spur orthodontists to action in finishing up their cases with normal dispatch. However, grave harm is emerging from the idea of rapid treatment because, as in all new ideas and plans, somebody gets excited and carries the matter to the ridiculous stage, and a resultant compensation movement follows, which colloquially means "back to earth."

There is no unusual, extraordinary, or secret method for correction of malocclusion other than hard work and close application to detail, with a thorough understanding and knowledge of the fundamentals of the subject. Without these, relapse is the ghost that walks in the night, notwithstanding the variation in types of appliances or the time utilized.

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Book Review

Recent Advances in Anesthesia and Analgesia

Recent Advances in Anesthesia and Analgesia. By Langton Hewer, M.D., Anesthetist to St. Bartholomew's Hospital, London. Illustrated, published by P. Blakiston's Son & Co., Inc., Philadelphia, Pa.

Anesthesia, like so many other departments of medicine and dentistry, is becoming more and more specialized as time goes on. It is obvious that this little volume does not aim to be a textbook in the art of anesthesia, and most elementary teaching and description of well known methods of anesthesia have been omitted. Its more comprehensive and broad object is plainly to provide a concise collection of some of the important and more recent advances made during the past few years in the subject of anesthesia.

The author particularly points out that in these days when novel methods and new drugs are being introduced almost daily, it is essential for the anesthetist to keep balanced and not to pander to the spectacular.

The book is well written, comprehensive and modern, and should be a valuable contribution to the subject of anesthesia in general.

NEWS AND NOTES

Chicago Centennial Dental Congress to Be Most Elaborate Meeting in History

A preview of the preliminary plans for the Chicago Centennial Dental Congress indicates clearly that the congress will be the most comprehensive and elaborate dental meeting ever staged. In the first instance it will combine the 75th annual session of the American Dental Association and the 69th annual meeting of the Chicago Dental Society. Sessions will be held in the Stevens Hotel August 7 to 12, 1933. Those who have attended both of these meetings in past years can readily appreciate that the combination will produce an unprecedented dental gathering. Add to this the fact that the dates coincide with the peak period of A Century of Progress Exposition (Chicago World's Fair) and the setting for the meeting becomes ideal.

Beginning June 1, 1933, the opening date of the World's Fair, and continuing until the closing date, October 31, 1933, the Congress in cooperation with the American Dental Association will present an elaborate popular dental exhibit in the Hall of Science on the Fair Grounds. It is anticipated that at least 50,000,000 persons will view this exhibit.

Registration of visitors will begin Saturday and continue throughout Sunday. In the evening the annual dinner and meeting of the American College of Dentists will be held.

Monday. The exhibitors' demonstrations will be the first order of the day in the Grand Ballroom. Later will be the first showing of the section on scientific exhibits, followed by historical addresses in all sections. The first general session will be held in the afternoon featured by the presidents' addresses. In the evening the various dental fraternities will hold their annual dinners.

Tuesday. At the first morning general session will be given a paper on operative dentistry, mouth hygiene and prevention. This session will be held concurrently with lecture demonstrations in all the sections. The second afternoon general session will feature a paper on full denture prosthesis. In addition there will be papers read in all the sections. At the evening general session there will be a guest speaker of national reputation whose topic will be nondental and of general interest to all visitors.

Wednesday. The second morning general session will be given over to a paper on partial dentures, crown and bridge, and ceramics. At the same time there will be general clinics in all the sections. In the afternoon there will be general sessions devoted to oral surgery, anesthesia and radiology, with papers read in all of the sections. The evening will be devoted to annual banquets of such organizations as the College Alumni Associations, Dental Hygienists, Dental Assistants, etc.

Thursday. A paper on orthodontia will headline the morning general session. Concurrently there will be lecture demonstrations. In all the sections the afternoon general session will be given over to oral pathology and therapeutics. The various sections will be occupied with the presentation of papers. The evening has been designated as Gala Night at the Exposition. The nature of the program for this evening has not yet been fully developed, but it is safe to say that the memory of it will linger long in the minds of those present.

Friday. The morning general session will be devoted to a consideration of the biologic sciences and research, with a paper on the subject. Concurrently there will be lecture demonstrations in all sections. The afternoon general session will be devoted to a paper on dental health. At the same time there will be papers in the various sections. The President's Ball, the crowning social event of the Congress, will be held in the evening.

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Saturday. Special attention will be paid the manufacturers' exhibit in the morning. General clinics will be held in all sections, and also special clinics in the Grand Ballroom. At 12 noon the Congress closes.

This is a very sketchy outline of the program. There will be many recreational activities, such as golf, trapshooting, etc., which remain to be arranged. In future issues of this Journal we shall go more into detail about the meeting, the World's Fair and Chicago as a convention city.

In the meantime, it is our desire that every member of the American Dental Association consider that he has been personally invited to attend this history-making congress.

ARTHUR D. BLACK, President,
STANLEY D. TYMAN, Secretary.

Washington University Dental Alumni Association

The Washington University Dental Alumni Association will hold its annual meeting February 20, 21, 22, 1933.

This meeting will be unusual in that it is to consist of intensive postgraduate courses and special lectures, which are to be given by the members of the faculty of Washington University Dental School. No charge will be made for these courses.

Due to the attractive program a large attendance is expected.

The meeting will be held at the Washington University Dental School, 4559 Scott Avenue, St. Louis, Mo.

LEO M. SHANLEY, Secretary,
4482 Washington Avenue,
St. Louis, Mo.

The American Society for the Advancement of General Anesthesia in Dentistry

The next meeting of the American Society for the Advancement of General Anesthesia in Dentistry will be held on Monday evening, December 12, at the Barbizon-Plaza Hotel, 58th Street and Sixth Avenue, New York City.

The speaker will be Dr. Harry M. Seldin, director of the Division of Dentistry, Department of Hospitals, New York City. Dr. Seldin will read a paper on "Gas-Oxygen Anesthesia from the Dental Viewpoint."

Dr. A. B. Rosoff, New Haven, Conn., and Dr. H. J. Field, Newark, N. J., will discuss the paper preceding the general discussion.

The meeting will start with a dinner at 7 P. M., and the scientific session will begin at 8:15 o'clock. Reservations for the dinner may be made with Dr. M. Hillel Feldman, President.

M. HILLEL FELDMAN, President,
730 Fifth Avenue, New York City,
LEONARD S. MORVAY, Secretary,
76 Clinton Avenue, Newark, N. J.,
JAMES T. GWATHMEY, Honorary President,
133 E. 58th Street, New York City.

American Society of Orthodontists

The thirty-second annual meeting of the American Society of Orthodontists will be held in Oklahoma City, Oklahoma, April 19, 20 and 21, 1933.

A cordial invitation is extended to all ethical practitioners of dentistry and orthodontia to attend this meeting.

WM. E. FLESHER, President,
Medical Arts Bldg.,
Oklahoma City, Okla.

CLAUDE R. WOOD, Secretary-Treasurer,
Medical Arts Bldg.,
Knoxville, Tenn.

Greater New York December Meeting

Practical dentistry will be the keynote of the eighth annual Greater New York December Meeting to be held at the Hotel Pennsylvania, New York City, December 5 to 9, 1932.

The program has been planned to lay particular stress on the factors that count for efficiency in the everyday practice of the profession.

The meeting will be under the auspices of the First and Second District Dental Societies of the State of New York.

Details of the program will be announced later.

An exhibit by dental manufacturers will continue throughout the meeting.

CARROLL B. WHITCOMB, Chairman.

Sixty-Seventh Annual Meeting of Ohio State Dental Society

The Ohio State Dental Society will hold its 1932 meeting in Cleveland on December 5, 6, and 7. Arrangements are being made for a program by outstanding men in the various specialties of dentistry. The program will be divided into the four sections of dentistry, and the four sections will be in session at one time, thus insuring a maximum diversity of choice in the type of program.

EDWARD C. MILLS, Secretary,
255 East Broad Street,
Columbus, Ohio.

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William Cummins Fisher
1876-1932